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STATISTICS OF POST DIPHTHERITIC PARALYSIS
AND
THE PATHOLOGY OF THE HEART IN CARDIAC PARALYSIS
OF DIPHTHERIA.

Being a Thesis for the Degree of M.D. of
Edinburgh University.

b y

B E R N A R D E . M Y E R S ,
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GENERAL INTRODUCTION TO THESIS.

This Thesis has been conducted essentially with a view to investigate the statistics of cardiac paralysis in Diphtheria, so as to include all the interesting and important points: and also to ascertain the particular part which the heart itself plays in this condition.

I hope that as regards the heart, to be able to show that there are very definite and grave pathological conditions in the heart muscle, etc., and which seem to be always present in this form of cardiac paralysis.

As the investigations of cardiac paralysis statistics meant going over the whole of the cases of diphtheria in the case books of the hospital, I determined afterwards to do all the statistics of post-diphtheritic paralysis.

I N T R O D U C T I O N.

To Part I.

The important subject of "Post Diphtheritic Paralyzes" never needs much comment on the part of those contemplating work on this subject, for probably few subjects of the now prodigious array of medical facts, have more earnest workers. But here especially we find ever and anon, little problems for solution; and if indeed, much time and labour have borne their fruits in many important facts, yet the substantiating of these facts by others, always tends to make their position in medicine more secure and absolute. Without saying too much of the importance of Post Diphtheritic Paralysis, on account of their thousands of unfortunate victims annually, yet the history of Diphtheria and its paralyzes lends to it a unique touch of interest.

For we know that various passages in Hippocrates have bearing on this subject, and also its probable connection with the Syrian ulcer of Aretaeus; while Soranus of Ephesus and Aetius Amidenus of Byzantium make mention of the subject.

But/

But none of the early writers tell us much, and it is essentially when coming to the nineteenth century that we find an army of workers in the field, each adding his little to his predecessors, until ultimately an amount of all important and interesting facts were, and are being accumulated.

The vagueness of writers a few centuries back was of course only what could have been expected from their limited knowledge, and especially their often mixing up of Diphtheria with throat affections, non Diphtheritic.

Still Perez de Herrera in 1615 mentions what is evidently "Palatal paralysis" after Diphtheria; as also does Carnevali in 1620. Perhaps Severinus in 1643, in speaking of cases of sudden death, referred to what we now call "Cardiac Paralysis".

The mention of "Strabismus" was made by Chomel in 1749, and "Deglutition" by Fothergill in 1748; though of course scores of others must have observed the same phenomena long before.

Sam Bard, of New York, in 1771, brings to notice "Paresis of the Lower Limbs": and "almost total Blindness" and "a tottering gait" were reported by Hoffman in 1815; then Orillard in 1835, and Troussseau in 1851, published useful knowledge on the paralyzes.

Still/

Still more recent students galore piled stone upon stone, to make the monument of greater exactness, so characteristic of now-a-day work.

The following Statistics were done entirely at the Park Fever Hospital, Hither Green, where through the courtesy of Dr Birdwood, the superintendent of the Hospital, I was given carte-blanche to the books containing reports of every case of Diphtheria that has been attended to in the Hospital.

Owing to the Metropolitan Asylum's Board having only recently taken in Diphtheria, these tables just go back a few years.

Still, there are amply sufficient cases, to see clearly the main and important facts of the statistics, while perhaps a few things rather interesting will also be seen.

On account of the tables of 1898 not being arranged in every instance the same way as the 1899 tables, the latter are mentioned first, then the former; following these are comparisons of the two years; whilst finally comment is made with reference to the relation of the statistics of the Park Hospital to those of some other Hospitals. As the reports of the Medical Officers of Health to the Sanitary Authorities lay stress on the importance of giving "age periods"/

periods" and "sex" affected, these have mostly been followed out, especially in the 1899 tables; whilst the importance of season has not been ignored by any means.

As showing the liability of those who have had "previous throat affections", reasonably near to the Diphtheritic attack, to contract Diphtheria, a list is made up of those who had previously suffered from "Chronic Sore Throat", "measles", and "scarlet".

Special interest is taken throughout of the cases of "cardiac" and "diaphragmatic" paralyses; and the use of "Antitoxin" also gets a little notice.

In the 1899 tables "the day of the disease on which the advent of the paralysis or paresis occurs" is mentioned in most cases; and the "period of duration in cardiac cases, and in diaphragmatic paralysis" is given.

There are unfortunately a few ocular cases in which nothing definite is put into the notes, and so these had just to be returned as ocular.

Finally, to show the relation of the dates of onset, when more than one form of paralysis or paresis exist in the same patient, these have generally been arranged suitably for this purpose.

As regards literature to which reference is made,

I must apologise for the small space given to same; but the truth is, that after having perused an amount of statistical work, I found little of the nature to which I desired to refer.

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It is certain that in the case of the Ciliary Muscle, the Pupil, Deglutition, Larynx, Lower Limbs, Generalised Paralysis, Sensory Paralysis, that not all the cases have been noted, while no instance of Lip Paresis is mentioned. However, in the case of cardiac, diaphragmatic, palate, external rectus of eye, etc. every case that has occurred has been reported in the clinical notes, from which these statistics were prepared.

POST DIPHTHERITIC PARALYSIS.

STATISTICS:-- YEAR 1899.

INCIDENCE OF PARALYSIS IN AGE PERIODS
AND SEX.

(Total paralysis and paresis for year 1899 were
275 cases.)

0 to 1 year:

Males.

Females.

2.

3.

Total under 1 year, 5 cases.

1 to 2 years:

Males.

Females.

7.

9.

Total 1 to 2 years, 16 cases.

2 to 3 years:

Males.

Females.

9.

8.

Total 2 to 3 years, 17 cases.

3 to 4 years:

Males.

Females.

22.

15.

Total 3 to 4 years, 37 cases.

4 to 5 years:

Males.

Females.

19.

10.

Total 4 to 5 years, 29 cases.

5 to 6 years:

Males.

Females.

15.

25.

Total 5 to 6 years, 40 cases.

6 to 7 years:

Males.

Females.

19.

16.

Total 6 to 7 years, 35 cases.

7 to 8 years:

Males.

Females.

17.

16.

Total 7 to 8 years, 33 cases.

8 to 9 years:

Males.

Females.

7.

9.

Total 8 to 9 years, 16 cases.

9 to 10 years:

Males.

Females.

8.

6.

Total 9 to 10 years, 14 cases.

10 to 11 years:

Males

Females.

8.

4.

Total 10 to 11 years, 12 cases.

11 to 12 years:

Males.

Females.

3.

2.

Total 11 to 12 years, 5 cases.

Over 12 years: (includes those in their 13th year):

Males.

Females.

11.

5.

Ages.

13, 13, 15, 12, 14,

14, 15, 35, 12, 15.

13, 20, 13, 14, 14, 16.

Total over 12 years, 16 cases.

Now of 275 cases of paralysis and paresis
during 1899 there were 147 MALES and 128 FEMALES.

From 0 to 5 years:

Males

Females.

59.

45.

Total 5 years and under, 104 cases.

From 5 to 10 years:

Males.

Females.

66.

72.

Total 5 to 10 years, 138 cases.

From 10 years onwards:

Males.

Females.

22.

11.

Total over 10 years, 33 cases.

Taking the 5 year period 3 to 8, we get as follows:-

3 to 8 years:

Males.

Females.

92.

82.

Total 3 to 8 years, 174 cases.

Thus, of 275 cases for all ages, we find that there were 174 cases of paralysis and paresis between the ages of 3 and 8 years, equalling 63.2% of total.

Again, we see that there were 40 cases of paralysis and paresis in the 5 to 6 year period, equalling 14.5 of the total cases for all ages, which in the above is in excess of any other period of life. The Females suffered most severely in the 5-6 year period, while the Males fared worst in the 3-4 year period, but the latter does not prove such to be the case absolutely/

absolutely without stating the number of each sex admitted from 3 to 4 years and 5 to 6 years, respectively.

"SEX DISTRIBUTION";

with regard to the Total number of cases of
Diphtheria admitted; Paralysis; and Death in
cases of Paralysis.

"Total number of cases" of Diphtheria in the
Wards during 1899, were 1276.

Of these cases, 640 were males, and 636 females.

During the same year there were:

275 cases of "PARALYSIS & PARESIS"

147 of these cases were in MALES,

128 were in FEMALES.

Thus, considering the number of males and females admitted with Diphtheria were practically the same, there were more males affected with Paralysis than females; or to be more accurate, 53.5 per cent were males, and 46.5 per cent were females.

There were 80 DEATHS in cases of Paralysis, of which 44 occurred in MALES and 36 in FEMALES, which equal 55 and 45 per cent respectively, of the total deaths.

One would certainly expect more deaths among the males, as there were more affected with Paralysis.

The "PER CENTAGE OF CASES OF PARALYSIS AND PARESIS TO THE TOTAL NUMBER OF CASES OF DIPHTHERIA admitted" was 21.5 per cent.; so that in this instance about one case in five suffered from Paralysis.

The "PERCENTAGE OF FATAL CASES to the total number of cases of Paralysis" was 29 per cent.

So that about one case in $3\frac{1}{2}$ cases, or 2 cases in 7 died.

DEATHS FROM "CARDIAC PARALYSIS"

By cardiac paralysis, or as it has sometimes been called, vagus paralysis, I mean to infer those cases which are clinically characterised by:-

1. Heart Failure.
2. Vomiting.
3. Blueness of skin and mucous membranes.
4. Generally coldness of extremities in final stages.

Other symptoms, as convulsions, etc., are sometimes present, but the few above clinical symptoms are those generally observed; though, as we shall see later on, there are other symptoms more or less characteristic of the malady.

Total number of Deaths for year:

Total of Deaths due to Cardiac Paralysis: 64.

So that only 16 deaths were due to other causes, whilst 80 PER CENT OF DEATHS WERE DUE TO CARDIAC PARALYSIS.

There were altogether 64 cases of CARDIAC PARALYSIS", all of course as above, being fatal. This equals 23 PER CENT OF ALL FORMS OF PARALYSIS FOR YEAR.

Of Cardiac Paralysis Deaths, 33 were in MALES.
31 were in FEMALES.

Effect of "SEASON"

in Cardiac Paralysis.

January	5 cases.
February	6 "
March	4 "
April	2 "
May	3 "
June	1 case.
July	9 cases.
August	4 "
September	4 "
October	11 "
November	10 "
December	5 "

TOTAL 64 "

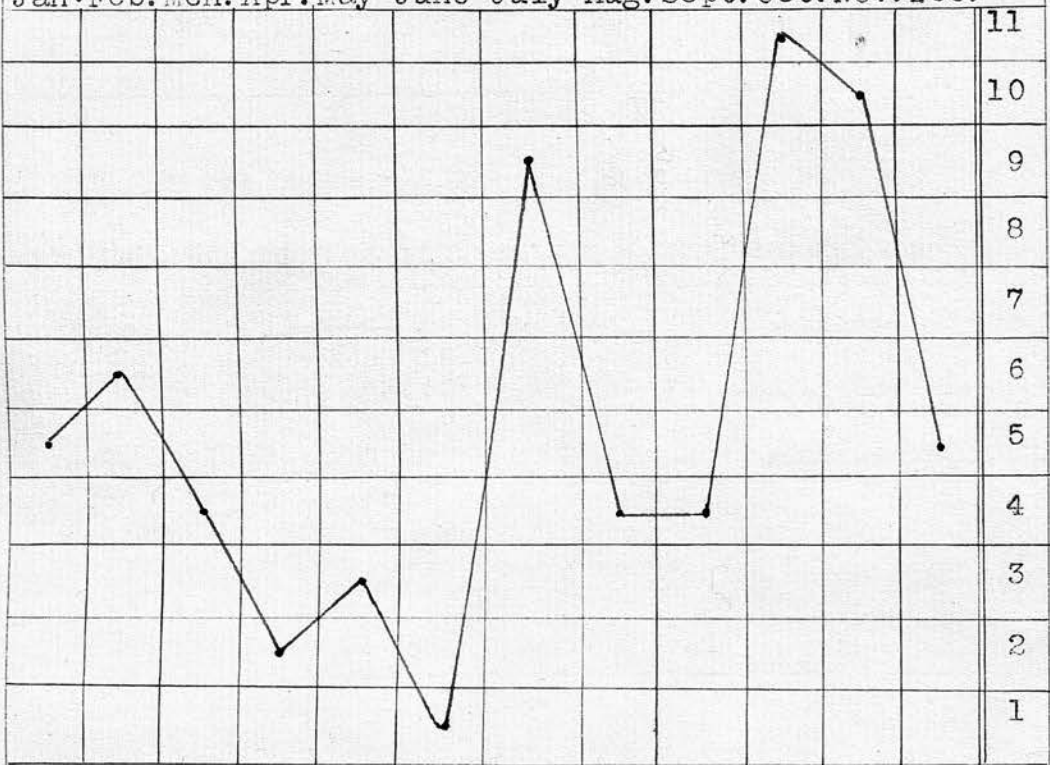
In this table October and November together claim 21 cases; or one third of the entire cases occurred at end of autumn and beginning of winter. April, May and June - end of spring and beginning of summer - show the fewest number of cases, only 6 altogether/

altogether, or about one eleventh of Total cases.

December, January & February all show a fair proportion being nearly one twelfth of total cases in each instance. July shows a rise, whilst August and September show a big fall again.

It is better seen thus:-

Jan. Feb. Mch. Apr. May June July Aug. Sept. Oct. Nov. Dec.



"AGE PERIODS" of Cardiac Paralysis.

(year periods)

0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9

1. 4. 10. 7. 7. 6. 12. 6. 6.

9-10 10-11 13-14.

1. 2. 2.

Here we find the great proportion of cases occurring between the ages of 2 and 9 inclusive, the majority being in the 6 to 7 period. After 9 years there is a great falling off in these cases.

The "NUMBER OF DAYS AFTER THE BEGINNING OF
ATTACK OF DIPHTHERIA, THAT THE SYMPTOMS AND SIGNS
OF CARDIAC PARALYSIS WERE FIRST NOTED."

In one instance the symptoms came on upon the second day of illness, while in one other case it seems to have been on the thirty-sixth day. These mark the two extremes. Of the 64 cases the AVERAGE DATE upon which symptoms appeared was the 7th day.

"DURATION OF CARDIAC PARALYSIS"

The extremes were 1 day and 14 days; though perhaps one may express some doubt as to the latter date.

The AVERAGE DURATION of life, after Cardiac Paralysis was first clinically noted, was 4 days.

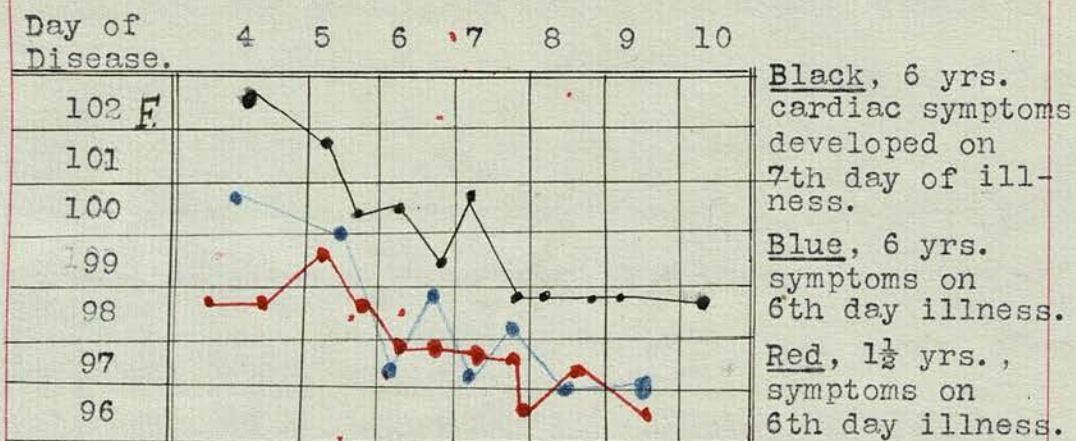
"STRYCHNINE" in Cardiac Paralysis.

In nearly every single instance of these cases Antitoxin/

Antitoxin was injected, but as some people have spoken of the virtues of Strychnine in cardiac cases, perhaps it would not be out of place to mention that strychnine was given a trial in 9 of these cases, but no obvious benefit could be observed therefrom.

"TEMPERATURE" in Cardiac Paralysis

A fact which strikes one forcibly after looking over some hundred odd charts, is that there seems to be one particular kind of chart which occurs in most cases of Cardiac Paralysis, especially seen in those cases which run their course in 6 to 9 days. Thus:--



Of these three charts, the one in blue is that which by far most frequently occurs. In this chart the patient came in on the 4th day of disease with temperature of nearly 101°, which goes to 100° on 5th day illness, then on the 6th day there is a drop to 97°, and though the temperature rose to normal again/

again for a short time, it kept near the 97° till the 9th day disease, when it was below 97°, and death occurred. The red chart is somewhat similar to the one in blue, only that the initial temperature was not so high.

Greatly swollen "CERVICAL GLANDS" in the early stages of Cardiac paralysis.

Large numbers of these cases show early great swelling of cervical glands generally bilateral .

It certainly does not occur in all cases for there are a fair proportion without, still cases early showing great enlargement of cervical glands require urgent attention and frequently turn out to be cardiac cases.

Large Amount "MEMBRANE" in Cardiac Cases.

Though many of these cases show great masses of membrane, it is not of great diagnostic importance, for sometimes other kinds of paralysis have such membrane, and occasionally in cardiac cases there is very little.

"SUPPRESSION OF URINE"

This occurs now and again, in the final stages.

HAEMORRHAGIC CASES with Cardiac Paralysis.

Of 64 cases Cardiac Paralysis, in 13 of these cases there were haemorrhages; equal to 1 in 5 cases as haemorrhagic.

"DIAPHRAGMATIC PARALYSIS"

There were 21 cases of this form of paralysis during the year, which compared to the total cases of all forms of paralysis and paresis during the same period, 275, gives the result that 7.6 PER CENT. OF CASES WERE DIAPHRAGMATIC.

It may be here mentioned that as Diaphragmatic Paralysis rarely occurs without some other paralysis or paresis, these cases with only one or two exceptions, contain various other parts affected in the same patient.

These will be mentioned in tabular form later on.

"DEATHS" IN DIAPHRAGMATIC PARALYSIS.

Of 21 cases of the above, 11 terminated fatally, and 10 recovered, so practically A HALF OF THE PATIENTS SUCCUMBED.

"COMPARED TO THE TOTAL DEATHS FOR YEAR", from all forms Paralysis - we find that 13.7 per cent. were due to Diaphragmatic Paralysis.

"SEX DISTRIBUTION" in Diaphragmatic Cases.

Males.

Females.

13.

8.

Total: 21 cases.

"AGE DISTRIBUTION" in same.

(year periods).

<u>0-1</u>	<u>1-2</u>	<u>2-3</u>	<u>3-4</u>	<u>4-5</u>	<u>5-6</u>	<u>6-7</u>	<u>7-8</u>	<u>8-9</u>	<u>9-10</u>	10
2.	3.	6.	2.	5.		1.	1.			

10-11.

1.

Most cases occurred between the ages of 2 and 6
years. -----

"SEASON".

Here learn nothing particular, as with the exception of there being no cases in May and June, there was a fairly equal distribution for the various months.

"DAY OF DISEASE UPON WHICH DIAPHRAGMATIC SIGNS WERE
FIRST NOTED CLINICALLY."

The two extremes were 11 and 50 days respectively, while the AVERAGE time was 37 days.

"DURATION OF FATAL CASES"

after Paralysis set in first.

The least time was 3 days, while one case is put down at 65 days, but this case is not counted in the average, as when first signs were noted they were doubtful, and probably the diaphragm did not suffer till some little time later on.

The AVERAGE DURATION was $6\frac{1}{2}$ days.

In the above list many cases started first as partial implication of Diaphragm, while in other cases the diaphragm was not working either side, when first noticed clinically to be at fault.

"VARIOUS FORMS OF PARALYSIS OR PARESIS WHICH WERE ASSOCIATED WITH DIAPHRAGMATIC PARALYSIS, AND THE DAY OF ONSET IN EACH CASE, COUNTING FROM INITIAL SYMPTOMS OF DIPHTHERIA TO FIRST TIME THE PARALYSIS, ETC., WAS

NOTED."

PALATE AND DIAPHRAGM (4 cases).

Case I.

Age 4. Male.

Palate: 50 days.
Diaphragm: 50 "

Case II.

Age 3. Female.

Palate: 24 days.
Diaphragm: 27 "

<u>Case III.</u>	Age 5.	Male.
	Palate:	11 days.
	Diaphragm:	11 "

<u>Case IV.</u>	Age $3\frac{1}{2}$.	Male.
	Palate:	35 days.
	Diaphragm:	46 "

The point of interest here is that the palate was always affected either before or at the same time as the diaphragm.

PALATE, INTERNAL RECTUS OF EYE, MUSCLES OF DEGLUTITION, and DIAPHRAGM (2 cases).

<u>Case I.</u>	Age 3.	Male.
	Palate:	31 days.
	Deglutition:	32 "
	Internal Recti:	33 "
	Diaphragm:	36 "

<u>Case II.</u>	Age $1\frac{1}{2}$.	Male.
	Palate:	25 days.
	Deglutition:	37 "
	Internal Recti:	41 "
	Diaphragm:	61 "

It will be noticed that the same order was maintained in either case.

PALATE, OCULAR, DIAPHRAGM (2 cases).

<u>Case I.</u>	Age 5.	Female.
	Palate:	20 days.
	Ocular:	20 days.
	Diaphragm:	39 days.

<u>Case II.</u>	Age $1\frac{1}{2}$.	Male.
	Palate:	22 days.
	Ocular:	48 "
	Diaphragm:	46 "

Here the palate is first to suffer, but the ocular affection varied.

LARYNX, PALATE, EXTERNAL RECTUS EYE, DIAPHRAGM.

(1 case).

<u>Case I.</u>	Aged 5.	Female.
	External Rectus:	31 days.
	Palate:	36 "
	Larynx:	37 "
	Diaphragm:	40 "

DEGLUTITION, DIAPHRAGM, INTERNAL RECTUS EYE, CILIARY.

(1 case).

<u>Case I.</u>	Age $2\frac{1}{2}$	Male.
	Deglutition:	29 days.
	Diaphragm:	34 "
	R. Internal Rectus	35 "
	Ciliary:	36 "

RIGHT EXTERNAL RECTUS, FLEXORS NECK, DIAPHRAGM.

(1 case)

Diaphragm on 38th day.

PALATE, EXTERNAL RECTUS EYE, DIAPHRAGM (3 cases).

<u>Case I.</u>	Age 7.	Male.
	Palate:	20 days.
	External Rectus:	17 "
	Diaphragm:	43 "

<u>Case II.</u>	Age 5.	Male.
	Palate:	24 days.
	External Rectus:	39 "
	Diaphragm:	47 "

<u>Case III.</u>	Age $2\frac{1}{2}$.	Female.
	Palate:	29 days.
	External Rectus:	45 "
	Diaphragm:	39 "

The variable position of External Rectus is seen, though palate generally suffers first and diaphragm generally last.

LARYNX, PALATE, DIAPHRAGM (1 case).

<u>Case I.</u>	Age 8.	Female.
	Palate:	19 days.
	Diaphragm:	25 "

DEGLUTITION AND DIAPHRAGM (1 case).

<u>Case I.</u>	Age $2\frac{1}{2}$	Female.
	Diaphragm:	32 days.
	Deglutition:	35 "

PALATE, DEGLUTITION, LARYNX, DIAPHRAGM (3 cases).

<u>Case I.</u>	Age 3.	Male.
	Palate:	32 days.
	Deglutition:	38 "
	Larynx:	38 "
	Diaphragm:	38 "

<u>Case II.</u>	Aged 5.	Female.
	Palate:	22 days.
	Diaphragm:	42 "

<u>Case III.</u>		Male.
	Palate:	37 days.
	Diaphragm:	39 "

From the above lists of cases we see that the Palate is generally the first attacked, and the Diaphragm as a rule the last. The remainder of those parts mentioned show a variable position.

"PALATE", PARESIS AND PARALYSIS.

110 Cases where Palate alone affected and equal to 40 per cent. of total number of cases of various kinds of Paralysis and Paresis for year.

"SEX".

61 cases were in MALES.

49 " " " FEMALES.

"AGE".

Minimum was $1\frac{1}{2}$ years.

Maximum " 35 "

Average Age was 7 years.

"DAY OF ONSET."

Minimum time was 8th day of Diphtheria.

Maximum " " 55th " " "

Average " " 27th " " "

"PALATE and CILIARY."

There were 5 cases: of which 3 were in Males
and 2 in Females. AGES were 6, 7, 8, 9 and 11 years.

DAY OF ILLNESS when

<u>PALATAL Paresis.</u>		<u>CILIARY Paresis.</u>
I.	15th Day.	20th Day.
II.	40th "	24th "
III.	30th "	30th "
IV.	35th "	24th "
V.	12th "	49th "

So that sometimes Palate suffered first and at
other times ciliary muscle.

PALATE AND EXTERNAL RECTUS OF EYE.

These suffered together in different patients
27 times, fairly often, considering there were only
275 cases of paralysis, etc. altogether.

SEX.

<u>Males</u>	<u>Females.</u>
12 cases.	15 cases.

AGE

<u>Minimum:</u>	1½ years old.
<u>Maximum:</u>	11 " "
<u>Average:</u>	6 " "

PALATE and OCULAR. (3 cases).

(Here the particular part at fault in eye was not mentioned.) All were in females.

PALATE and RIGHT FACIAL PARESIS (1 case).

Case I. Age 12 years. Male.

Palate Paresis: 28th day illness.

R. Facial " 44th " "

PALATE, CILIARY, PUPILS.

Case I. Aged 9 years. Female.

Palate on 19th day illness.

Ciliary on 34th " "

Pupils on 34th " "

Case II. Aged 15 years. Female.

Palate on 41st day illness.

Ciliary on 50th " "

Pupils on 50th " "

The palate was in both cases affected a week or two before pupils and ciliary muscle, which in both cases suffered on same day.

PALATE and LARYNX.

Case I. Aged 5 years. Male.

Palate on 33rd day illness.

Larynx on 34th " "

Counting the cases Palate affected alone:	110.
Palate and Ciliary,	5.
Palate and External Rectus,	27.
Palate and Ocular,	3.
Palate and Right Facial,	1.
Palate, Ciliary, Pupils,	2.
Palate and Larynx,	1.
with Palate and Diaphragm,	<u>17.</u>

give a TOTAL OF TIMES PALATE SUFFERED AS 166.

so that of 275 patients to suffer from paralysis or paresis, in 166 of these patients the PALATE WAS AFFECTED either alone or with other forms paralysis, which equals 60 PER CENT OF ALL THE CASES.

GENERALISED PARALYSIS.

One case included amongst the Diaphragmatic cases, as the latter participated in final stages.

EXTERNAL RECTUS OF EYE.

<u>Right</u> (alone)	<u>Left</u> (alone)
----------------------	---------------------

7.	13.
----	-----

20 cases.

Right and Left together.

4 cases.

External Rectus (side not mentioned in notes)

7 cases.

Total = 31 cases.

Then Palate and External Rectus.

27 cases.

Various forms with External Rectus.

7 cases.

GRAND TOTAL = 65 cases in which the EXTERNAL RECTUS was involved, which equals 23 per cent of Total cases of paralysis and paresis.

SEX.

Males.

31.

Females.

34.

AGE.

Minimum: 10 months.

Maximum: 15 years.

Average: 5 years.

"DAY OF ONSET" from commencement of Diphtheria.

LEFT EXTERNAL RECTUS.

RIGHT EXTERNAL RECTUS.

Minimum: 14 days.

Maximum: 53 "

Average: 34 "

10 days.

113 "

50 "

INTERNAL RECTUS.

has been already mentioned in 3 cases where it was always involved with other forms paralysis.

OCULAR PARESIS.

There were 6 cases which were not described further than 'ocular'.

CILIARY PARESIS.

No isolated cases, all were in conjunction with other forms and have been duly mentioned. There were 8 cases.

PUPIL PARESIS.

Three cases of above occurred, in conjunction with other forms mentioned - 2 being with palate and ciliary, and 1 with External Rectus.

"DEGLUTITION"

Alone: 1 case.
Combined with other forms - 5 cases. (mentioned).
TOTAL: 6 cases.

The average time of onset was 32 days.

"LARYNX"

There were 6 cases in which larynx was affected along with other forms paresis. It came on generally about 35th day.

Paresis of LOWER LIMBS is several times mentioned in notes; but as it must have occurred much more often than what there is reference to, no further mention is made on the subject.

Isolated cases of RIGHT FACIAL PARESIS and
FLEXORS OF NECK have been noted.

DISTRIBUTION IN THE VARIOUS MONTHS OF PARALYSIS AND
PARESIS.

	<u>Cardiac</u>	<u>Diaphragmatic</u>	<u>All other Forms.</u>
January:	5 cases.	2 cases.	16 cases.
February:	6 "	1 case.	15 "
March:	4 "	1 "	16 "
April:	2 "	2 cases.	13 "
May:	3 "	-----	17 "
June:	1 case.	-----	10 "
July:	9 cases.	3 cases.	18 "
August:	4 "	3 "	33 "
September:	4 "	4 "	22 "
October:	11 "	1 case.	7 "
November:	10 "	1 "	11 "
December:	5 "	3 cases.	12 "
	<u>64.</u> "	<u>21</u> "	<u>190</u> "

TOTAL: 275 cases.

The cardiac and Diaphragmatic cases have been discussed before: under the heading "All other Forms" every kind of paralysis and paresis barring cardiac and diaphragmatic are included, but the majority of these cases are palate paresis.

The only noticeable points are the great number of cases in August - 33, and the comparatively small number/

number in October - 7; and it will be seen on looking at the table that just the opposite conditions obtain in cardiac paralysis, where there were rather few cases in August - 4, and the greatest number in October - 11.

The question may be asked - but are the number of Diphtheria patients always the same? Well, much about the same number in the Park Hospital, where the wards put aside for Diphtheria are pretty well full all the year, though of course sometimes there are short rushes of Diphtheria cases; but still admitting a little difference in some months that does not materially alter the facts put just previously.

"PATIENTS WHO HAVE SUFFERED FROM PARALYSIS AND HAVE HAD EITHER CHRONIC SORE THROAT, MEASLES, OR SCARLET, WITHIN A REASONABLE PERIOD PREVIOUS TO THE DIPHTHERIAL ATTACK."

Total cases paralysis: 275.

Had previous scarlet, etc. 155.

= 56 per cent of cases.

Now great numbers of these cases had large extension of membrane and possibly there is some relationship.

ANTITOXIN.

Of 275 cases paralysis for year 1899:

263 cases had antitoxin with 77 deaths.

12 " had no " " 3 deaths.

But as the number of cases without antitoxin was so small, no particular importance can be laid on the above.

The amount injected varied from 4,000 to 25,000 units, the average amount being about 8,000 units.

The patients are injected soon after entrance to wards, but where very large doses are given, instalments are injected on successive days.

POST DIPHTHERITIC PARALYSIS

(Continued)

STATISTICS:-- YEAR 1898.

(Total cases of Paralysis and Paresis for year
were 140.)

INCIDENCE OF PARALYSIS IN AGE PERIODS.

<u>0 to 1 year.</u>	<u>1 to 2 years</u>
1 case.	7.
<u>2 to 3 years.</u>	<u>3 to 4 years.</u>
15.	15.
<u>4 to 5 years.</u>	<u>5 to 6 years.</u>
15.	20.
<u>6 to 7 years.</u>	<u>7 to 8 years.</u>
20.	14.
<u>8 to 9 years.</u>	<u>9 to 10 years.</u>
8.	7.
<u>Over 10 years.</u>	
18.	

Here we find that from 2 to 8 years there were most cases paralysis, and in this instance especially from 5 to 7 years.

All cases above 10 years cover so many different ages that they cannot very well be compared to other periods.

The "TOTAL NUMBER OF CASES OF DIPHTHERIA" in 1898 were 683 in which occurred 140 cases of "PARALYSIS" = 20 per cent. of Diphtheria Cases.

"SEX" Distribution in Paralysis.

79 of these were in males = 56 per cent.

61 " " " " females = 44 per cent.

"DEATHS"

Total number deaths = 49.

" " cases paralysis = 140.

So that 35 per cent of cases of Paralysis ended fatally, about 1 in 3.

DEATHS FROM "CARDIAC PARALYSIS"

Forty-two deaths from above during 1898, death occurring of course in every case of cardiac paralysis.

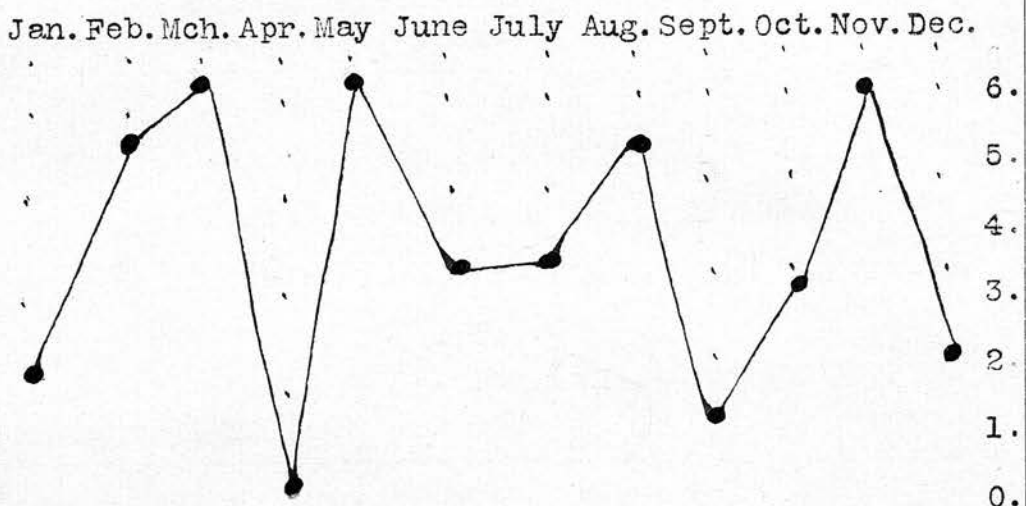
Being for all kinds paralysis 49 deaths, the 42 deaths in cardiac paralysis account for most of them and equal 85 per cent of Total Deaths in cases of paralysis.

Comparing the 42 CARDIAC PARALYSES to the 140 cases paralysis from all causes, the former ACCOUNTS FOR 30 PER CENT. of cases of paralysis for 1898.

Effect of "SEASON"
in Cardiac Paralysis.

January	2 cases.
February	5 "
March	6 "
April	-----
May	6 cases.
June	3 "
July	3 "
August	5 "
September	1 case.
October	3 cases.
November	6 "
December	2 "
TOTAL	<u>42</u> "

Thus in the above most cardiac cases occurred in
February, March, May, August and November.



The "NUMBER OF DAYS AFTER THE BEGINNING OF THE ATTACK
OF DIPHTHERIA THAT THE SYMPTOMS AND SIGNS OF CARDIAC
PARALYSIS WERE FIRST NOTED."

<u>Minimum</u>	3 days.
<u>Maximum</u>	63 "
<u>Average.</u>	7 "

DURATION OF CARDIAC PARALYSIS.

Minimum	1	day.
Maximum	7	days.
Average	3.5	"

HAEMORRHAGIC CASES WITH CARDIAC PARALYSIS.

There were 42 cases cardiac paralysis in 1898, and in 15 of these cases there were haemorrhages, equal to about 1 in 3 cases as haemorrhagic.

"DIAPHRAGMATIC PARALYSIS."

Eleven cases during the year 1898, which compared with Total cases paralysis of all forms during the years equals 7.8 per cent. of cases were Diaphragmatic.

DEATHS in Diaphragmatic Paralysis.

In 11 cases of this form paralysis there were 6 deaths, so that practically about a half of these cases succumbed.

COMPARED TO TOTAL DEATHS FOR YEAR.

from all forms paralysis - we find that 12.2 per cent. were due to Diaphragmatic Paralysis.

"SEASON"

in Diaphragmatic cases. On half of the cases occurred in December, but barring that, the cases show nothing worth noting.

SOME FORMS WHICH WERE ASSOCIATED WITH DIAPHRAGMATIC

PARALYSIS.

2 cases	{	Palate.
	(Diaphragm.
1 case.	(Palate.
	(Pupils.
	(External Rectus.
	(Diaphragm.
2 cases.	(Palate.
	(Pharynx.
	(Diaphragm.

PALATE PARESIS AND PARALYSIS.

55 cases of above during 1898 equal to 39 per cent. of all cases paralysis for year.

"DAY OF ONSET."

Minimum time was 7th day of Diphtheria.

Maximum " " 74th " " "

Average " " 30th " " "

"PALATE AND CILIARY."

5 cases.

"PALATE, CILIARY, PUPIL."

1 case.

"PALATE AND INTERNAL RECTUS."

2 cases.

* PALATE AND OCULAR.

1 case.

PALATE AND EXTERNAL RECTUS.

6 cases.

PALATE AND PUPIL.

1 case.

PALATE, EXTERNAL RECTUS, PUPILS.

1 case.

PALATE, DEGLUTITION, EXTERNAL RECTUS.

1 case.

PALATE WITH DIAPHRAGM (V. Supra.)

5 cases.

Cases where	Palate affected alone,	55.
" "	Palate and Ciliary	5.
" "	Palate, Ciliary and Pupil	1.
" "	Palate and Internal Rectus	2.
" "	Palate and Ocular	1.
" "	Palate and External Rectus	6.
" "	Palate and Pupil	1.
" "	Palate, Ext. Rectus, Pupil	1.
" "	Palate, Deglutition, Ext. Rectus..	1.
" "	Palate and Diaphragm	5.

78.

So that out of the Total Cases of paralysis of
all forms = 140, there were 78 cases in which the
PALATE suffered = 55% OF ALL CASES PARALYSIS.

"EXTERNAL RECTUS" (Eye).

<u>Right.</u>	<u>Left.</u>
3 cases.	1 case.

Right & Left together.
1 case.

"DAYS AFTER FIRST ILL."

Minimum	23 days.
Maximum	44 "
Average	34 "

"OTHER PARALYSIS WITH EXTERNAL RECTUS."

10 cases.

Total cases in which External Rectus suffered, 15,
equal to 10 PER CENT OF ALL KINDS PARALYSIS.

"LARYNX"

was affected once with External Rectus.

"INTERNAL RECTUS" (Eye)

Twice paresed with Palate.

"CILIARY"

With Palate 5 cases.

" " & Pupils 1 case.

6 cases.

"PUPILS"

4 cases, generally with Palate and other eye muscles.

"DEGLUTITION"

With Palate and External Rectus. 1 case.

" " " Diaphragm. 2 cases.

" " 1 case.

4 cases.

"GENERALISED PARALYSIS."

7 cases.

"SENSORY PARALYSIS"

Legs. 1 case.

This is probably inaccurate and probably several other cases presented the same phenomenon which was not noted.

"DISTRIBUTION IN THE VARIOUS MONTHS OF PARALYSIS
AND PARESIS.

	Cardiac.	Diaphragmatic.	All other Forms.
January:	2 cases.	-----	5 cases.
February:	5 "	1 case.	4 "
March:	6 "	2 cases.	5 "
April:	-----	-----	1 case.
May:	6 cases.	-----	5 cases.
June:	3 "	1 case.	5 "
July:	3 "	-----	6 "
August:	5 "	1 case.	6 "
September:	1 case.	-----	7 "
October:	3 cases.	-----	9 "
November:	6 "	-----	14 "
December:	2 "	6 cases.	20 "
	<hr/> 42 "	<hr/> 11 "	<hr/> 87 "

TOTAL: 140 cases.

A noticeable point is the number of cases not cardiac or diaphragmatic, but chiefly palate, in November and December.

ANTITOXIN was used in all the cases but 12 during 1898.

"PATIENTS WHO HAVE SUFFERED FROM DIPHTHERIAL
PARALYSIS AND HAVE HAD EITHER CHRONIC SORE THROAT,
MEASLES, OR SCARLET, WITHIN A REASONABLE PERIOD
PREVIOUS TO DIPHTHERIAL ATTACK."

Total cases all forms paralysis	140.
Had Chronic Sore Throat, etc.	83.
or 59 per cent.	

STATISTICAL COMPARISONS BETWEEN THE YEARS

1899 and 1898.

"CASES DIPHTHERIA IN WARDS.

<u>Year 1899.</u>	<u>Year 1898.</u>
1276 cases.	683 cases.

"CASES PARALYSIS."

<u>Year 1899.</u>	<u>Year 1898.</u>
275 cases.	140 cases.
= 21.5 per cent.	= 20 per cent.

respectively of Total cases Diphtheria for their
particular years.

"SEX" Distribution in cases with Paralysis.

<u>Year 1899.</u>		<u>Year 1898.</u>	
<u>Males.</u>	<u>Females</u>	<u>Males.</u>	<u>Females.</u>
147.	128.	79.	61.
= 53.5%.	= 46.5%.	= 56%.	= 44%.

The above is of importance in the 1899 year,
as the number of males and females admitted with
Diphtheria is noted, but this was not done in the
1898 year. In 1899 males and females admitted with
Diphtheria were practically equal in number.

"DEATHS" IN CASES OF PARALYSIS.

<u>Year 1899.</u>		<u>Year 1898.</u>
<u>Males.</u>	<u>Females.</u>	
44.	36.	
= 55%.	= 45%.	
<u>Total Cases.</u>		<u>Total Cases.</u>
80.		(Deaths). 49.
= 29%.		= 35%.

respectively of cases of paralysis ended fatally in
their particular years.

This would indicate that about 1 case in 3 cases
of paralysis terminate in Death. (This is irrespec-
tive of Sex.)

"DEATHS FROM CARDIAC PARALYSIS."

<u>Year 1899.</u>	<u>Year 1898.</u>
64 deaths.	42 deaths.
= 80% deaths.	= 85% deaths

respectively of all forms paralysis.

"PROPORTION OF CARDIAC PARALYSIS" TO ALL FORMS
PARALYSIS.

<u>Year 1899.</u>	<u>Year 1898.</u>
23%	30%.

So that about 1 case in every 4 cases of all forms
paralysis is cardiac.

EFFECTS OF "SEASON" in Cardiac Paralysis.

There is no close agreement between the two years, as is seen on looking at the tables given before; but the number of cases in November is in each case large, and equal to 2 or in some cases 3 of the other months. December shows a very moderate number of cases in both years, and same with January. February and March do not agree in their comparisons with the same months in the two years. April shows very few cases; in 1898 none. May, June, July and August of 1899 do not agree with same months in 1898. "There is certainly a fair similarity between the Septembers, Octobers, Novembers and Decembers, and Januaries, and little more can be said."

"THE NUMBER OF DAYS COUNTING FROM THE BEGINNING OF
ATTACK OF DIPHTHERIA THAT THE SYMPTOMS AND SIGNS OF
CARDIAC PARALYSIS WERE FIRST NOTED."

	<u>Year 1899.</u>	<u>Year 1898.</u>
Minimum:	2nd day.	3rd day.
Maximum:	36th "	63rd "
Average:	7th "	7th "

These show that whereas cardiac paralysis may show itself on 2nd or 3rd day of diphtheria, yet it is generally seen on the 7th day of disease.

DURATION OF CARDIAC PARALYSIS.

	<u>Year 1899.</u>	<u>Year 1898.</u>
Minimum	1 day.	1 day.
Maximum	14? "	7 "
Average	4 "	3.5 "

Thus we find that there may be only 1 day or 7 days, or more, but as a rule death takes place on the 3rd or 4th day of clinical signs and symptoms.

TEMPERATURE IN CARDIAC PARALYSIS.

The general sort of chart obtained, which has been already explained, agrees in the two years.

HAEMORRHAGIC CASES with Cardiac Paralysis.

<u>Year 1899.</u>	<u>Year 1898.</u>
<u>1 case in 5</u> was haemorrhagic:	<u>1 case in 3</u> was haemorrhagic.

The haemorrhages generally were subcutaneous, and on the legs or elbows as a rule. Bleeding from stomach, throat and nose also occurred.

DIAPHRAGMATIC PARALYSIS.

<u>Year 1899.</u>	<u>Year 1898.</u>
7.6%	7.8%.

of all cases paralysis were diaphragmatic. These figures very closely agree for the years stated.

"DEATHS" in Diaphragmatic Cases.

Year 1899.

Year 1898.

about 50%.

about 50%.

These figures also agree.

COMPARED TO TOTAL DEATHS FOR YEAR."

from all forms paralysis, the results were as follows:

Year 1899.

Year 1898.

13%

and

12.2%.

of deaths were due to Diaphragmatic Paralysis.

"SEASON" tells us practically nothing.

Association of Diaphragmatic with various other forms paralysis has been already noted in the respective years.

PALATE PARESIS & PARALYSIS.

Year 1899.

Year 1898.

40%.

39%.

of all forms paralyse.

DAY OF ONSET.

Year 1899.

Year 1898.

Minimum: 8th day of Diphtheria: 7th day Diphtheria.

Maximum: 55th " " " 74th " "

Average: 27th " " " 30th " "

The minimum time and the average time agree very well.

"TOTAL CASES IN WHICH PALATE PARALISED EITHER ALONE
OR ALONG WITH OTHER FORMS OF PARALYSIS.

Year 1899.

Year 1898.

60%.

and

55%.

of all cases of paralysees in each year.

EXTERNAL RECTUS OF EYE

was involved alone and with other paralysees as
follows:--

Year 1899.

Year 1898.

23%.

10%.

of cases of all forms paralysis.

Here we find a good deal of discrepancy.

Many of the forms of paralysis are not compared
here for the two years, because there is in many cases
no opportunity to compare; but they are fully de-
scribed in the 1899 year, and fairly well in the
1898 year.

"PATIENTS WITH PARALYSIS WHO HAVE HAD EITHER CHRONIC
SORE THROAT, MEASLES, OR SCARLET, WITHIN A REASONABLE
PERIOD PREVIOUS TO DIPHTHERIA ATTACK.

Year 1899.

Year 1898.

56%.

59%.

of all cases of paralysis.

These figures agree pretty closely, and it may
be/

be that those patients who have suffered comparatively recently with throat affections are more liable to a severer attack of Diphtheria with paralysis.

INCIDENCE OF PARALYSES IN "AGE PERIODS."

On comparing 1899 with the year 1898 some interesting results are seen.

<u>Year 1899.</u>	<u>Year 1898.</u>
<u>Total cases paralyses.</u>	<u>Total cases paralyses.</u>
275.	140.

so that practically twice as many cases in 1899 as 1898, and so we might expect in the cases the ratio of 2 to 1, and the result is certainly striking, thus:

	<u>Year 1899.</u>	<u>Year 1898.</u>
<u>0 to 1 year:</u>	5 cases.	1 case.
<u>1 to 2 years:</u>	16 "	7 cases.
<u>2 to 3 years:</u>	17 "	15 "
<u>3 to 4 years:</u>	37 "	15 "
<u>4 to 5 years:</u>	29 "	15 "
<u>5 to 6 years:</u>	40 "	20 "
<u>6 to 7 years:</u>	35 "	20 "
<u>7 to 8 years:</u>	33 "	14 "
<u>8 to 9 years:</u>	16 "	8 "
<u>9 to 10 years:</u>	14 "	7 "
<u>Over 10 years:</u>	33 "	18 "

Both years tally in that the worst years of life for Diphtheritic Paralysis are from 2 to 8 years, and perhaps the worst period is from 5 to 7 years of age.

SOME COMPARISONS WITH STATISTICS IN OTHER HOSPITALS,
ETC.

(1)
METROPOLITAN ASYLUMS BOARD'S HOSPITALS.

During the year 1898, re percentage of cases of paralysis to the total cases of Diphtheria, we find the following:--

"Showing incidence of Complications amongst 6,326 cases of Diphtheria completed during 1898,

PARALYSIS : Total cases 1229.

= 19.42 percentage incidence."

Under statistical comparisons the figures are found of the Park Hospital and are thus:--

Year 1899.

Year 1898.

21.5 percentage Incidence. 20.0 percentage Incidence.

And those figures fairly well agree with those of Metropolitan Asylums Board, all being near 20 per cent. of total number of cases of Diphtheria.

As regards FREQUENCY OF VARIOUS FORMS of paralysis, we have the following:-- (2)

"Nous avons négligé, dans ce mémoire, les cas dans/

-
- (1). Report, Statistical Committee, Metropolitan Asylums Board. Annual Report, 1898, Vol.II. Table II., Page 154.
 - (2). Maingault: "De la paralysie diphthérique. Recherches cliniques sur les causes, la nature, et le traitement de cette affection." Paris 1859. p.14.

dans lesquels la paralysie est limitée au voile du palais, et au pharynx, et qui sont d'une excessive fréquence."

"Paralysie du membres inférieurs	13
" Generalisée	64
" du voile du palais	70
Troubles de la sensibilité sans affaiblissement musculaire	8
Amaurose	39
Strabisme	10
Paralysie des muscles du cou et du tronc ...	9
Anaphrodisie	8
Paralysie de la vessie	4
" <u>du rectum</u>	6"

The foregoing was mentioned more on account of its interest for the time when it was written than anything else, for certainly we do not get similar figures now.

An interesting case is given in detail by A. H. Benson⁽¹⁾ of ONSET OF PARALYSIS, thus:--

"Primary throat affection lasted 4 weeks.
Ciliary Muscles affected in 5th week.
and continued so for about 7 weeks.

(1). A.H.Benson: "A case of paralysis of some of the ocular muscles after Diphtheria, with remarks on Pathology of the affection." Transactions, Ophthalmical Society M.K. London, 1892-3. Page 268.

Soft palate affected in 6th week.
and remained so for 2 weeks.
Hearing affected in 6th week.
and remained so about 1 week.
Lavatores palpebrarum affected in . 9th week.
continued so 1 week.
Recti external muscles affected ... 9th week.
remained so 3 weeks.
Convergent strabismus & diplopia,
present during 10th week.
Lasted about 3 weeks.
Numbness and tingling feet began .. 10th week.
and lasted about 3 weeks.

In year 1899 at Park Hospital the "Ciliary muscle"
as stated before, was affected variously from the
3rd to 7th week, average 4 to 5 weeks. In Benson's
case it was the 5th week.

Soft palate was affected in periods varying from
1 to 8 weeks, after first symptom diphtheria, the
average was 4 weeks. In the case just mentioned it
was the 6th week.

External Rectus affected in from 2 to 16 weeks,
average nearly 7 weeks. In the above case it was
the 9th week.

Of course it is not fair to compare a single
case with the results of many cases, but it is at
least/

least interesting, and it is making practical use of results to compare this well stated case with the average obtained from many cases.

Woodhead⁽¹⁾ quotes the following:--

"DATES OF ONSET OF PARALYSIS

Palate Muscles	5 to 15 days.
Oculo-motor	4 to 17 days.
Muscles of other parts.	10 to 14 days.
Paralytic heart failure.	5 to 10 days. (few cases 2nd day.) "

The "Palate 5-15 days" does not compare very near with the figures found here, 8-55 days.

The Oculo-motor, 4 - 17 days" also differs somewhat from 10-53 days (one case of 113 days) at the Park Hospital.

The "Paralytic heart failure, 5 to 10 days, occasionally 2" is very like the figures previously mentioned in 1899 year 2-15 days, though one case occurred on 36th day.

Burr ⁽²⁾ mentions the fact that the "PALATE IS USUALLY AFFECTED FIRST", which point almost everyone agrees upon: and he also states that often there is alone/

(1) G.S. Woodhead: "Post Diphtheritic Paralysis, B.M.J. Lond, 1898. II. P.593-6.

(2) C.W. Burr: "Nervous symptoms and lesions of Diphtheria" Trans.Path.Soc. Philadelphia, (1893-5) 1896. XVII. p.284-6.

alone the PALATE AND ACCOMODATIVE APPARATUS of eye, affected. It has certainly been the case in the present statistics that the palate has generally been the first to suffer, and as regards the latter statement there have been at least a few cases mentioned in each of the years 1899 and 1898 (v. ante.)

Re CILIARY, ABDUCENS OCULII, PUPIL and PALATE paralysis, Benson⁽²⁾ states as follows:--

- I. "That the Ciliary Muscle is one of the muscles most frequently affected."
- II. "That paralysis of abducens oculi is as rare as that of ciliary muscle is frequent."
- III. "That usually the pupil is unaffected and its motions unimpaired."
- IV. "That the muscles of palate are often, though not always the first to suffer,"

With regard to I., the ciliary muscle has certainly not been one of those most frequently affected in these statistics, and only now and again affected.

There have been far more cases of the abducens oculi being paralysed here than the ciliary muscle. This is quite contrary to the statement in II.

Both III. and IV. coincide with what has already been seen in these statistics.

(1) A. H. Benson: A case of paralysis of some of the ocular muscles after diphtheria, with remarks on the Pathology of the affection." Trans. of Ophthalmical Society, M.K. London, 1882-3. III. Page 269.



Re SEVERITY OF THROAT AFFECTION AND PARALYSIS

F. F. Gaiger⁽¹⁾ makes the following remarks:--

"It is generally the severe throat cases which are the most subsequently followed by paralysis, the mild ones usually escaping altogether."

Now as we have seen that in the year 1899 56 per cent. and in the year 1898, 59 per cent. respectively of all cases of Diphtheritic Paralysis had previously suffered from some throat affection, is it not possible that such cases would present a better nidus for extensive formation of membrane, and also be perhaps more liable to paralysis, providing the Bacilli be of ordinary virulence.

I wrote to the Dublin and Edinburgh Fever Hospitals, asking for information re the statistics on Post-Diphtheritic paralysis, especially as regards the cardiac form; but they both say that they find cardiac paralysis infrequent in their hospitals and I could not get any of their statistics for comparison, as they are unable to keep the patients long enough to see if paralyses will occur.

(1). F. F. Gaiger: "On Two rapidly fatal cases of Diphtheritic Paralysis." Lancet, Lond. 1899. II. P. 1222.

INTRODUCTION.

to PART II.

In this part of the Thesis an endeavour has been made to investigate the pathology of **CARDIAC PARALYSIS** due to the diphtheritic attack, but more especially to ascertain the changes to be found in the heart. It was originally intended to get if possible, a collection of twenty cases of Cardiac Paralysis, so as to make the results to be drawn from the examination of the various organs, etc-, the more likely to be accurate. Unfortunately, immediately after the work was started in June last year, ill health prevented any progress being made for many months, and made the chance, of getting twenty cases examined, rather remote.

Then again in many cases in which I had copious clinical notes, permission to do the post mortems could not be obtained, and ultimately the modest number of four cases, alone were available for investigation. This, though not a large number to report on, is still valuable in that the essential changes found in the four individual cases agree in the main features. As will be seen later on, there are definite changes always to be found in the heart, in the cases of cardiac paralysis of diphtheria, and details though of a less important nature, have also to/

to be noted in regard to the other parts examined.

Sections of the right and left ventricles of the heart were made in all cases; and the heart being a muscle in constant action, it was thought well to compare with it another muscle of great activity, viz., the diaphragm.

If activity, or should we say want of rest, renders the heart more liable to be attacked, then we should also expect changes in the diaphragm.

Pieces of the right intercostal muscles from about 5th space, have also been taken in most cases.

The kidney has been examined in all four instances, as the clinical history of many cases of cardiac paralysis included albuminuria and some have suppression of urine, and so demand attention being paid to this organ.

The spleen has been examined chiefly on account of the fact that it is alleged that the ferment formed in the diphtheritic membrane is absorbed into the system, and then acts upon the proteids in the spleen and other organs, and produces albumoses and an organic acid.

The vomiting, a prominent feature of cardiac paralysis, necessitated the examination of the stomach, to see if any local changes could account for it and as a rule pieces have been taken from the fundus and posterior surface.

The/

The bladder and the liver were also examined.

In the nervous system it would have been interesting to see the condition of the medulla, but permission could not be obtained for this.

The vagus nerve was examined in each case and in some cases both vagi.

Of course the points here were to see if the axis cylinders were intact, and whether the medullary sheaths presented any degeneration, or if any inflammatory condition could be found. This would be of importance in connection with the heart and stomach symptoms and signs.

The spinal cord was examined purely as a matter of interest to see the condition of, the cells of the anterior horns, the nerve fibres, neuroglia, and vessels of the cord.

Where I was enabled to, clinical notes were taken of the cases, but a few of the notes are by the Assistant Physician.

The post mortems were done by myself and the notes will be found in their places. The permissions for post mortems could not generally be obtained till some 20 hours or so after death; this is unfortunate, as one must allow for post mortem changes, still I have put down the facts just as I found them, and I think it will be agreed that the main facts were part of the disease of which the patient died and not due to post mortem changes.

The/

The various hardenings, embedding, and staining methods are mentioned later on so I need not delay on them here.

As far as I have had time, microphotography has been used to place the prints of important sections along side the facts stated, so as to make the work more compact. I fear my prints are not very brilliant, still they shew some points.

A selection of slides accompanies the thesis, in case they be wanted for approval.

In writing this part of the thesis, first of all the clinical symptoms chiefly met with in cardiac paralysis are stated; then deductions made from them as to the pathological conditions that were likely to, or may account for the clinical symptoms and signs.

Next follows an account of the various methods employed to demonstrate the changes expected.

Then the four cases are dealt with individually, the results gained from investigating them are compared with the literature upon the subject, whilst finally a summary of facts is made.

ARRANGEMENT OF THESIS.

P a r t II.

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I. DEDUCING FROM CLINICAL SYMPTOMS AND SIGNS,
WHAT PATHOLOGICAL CHANGES MIGHT WE EXPECT TO FIND
IN CASES OF "CARDIAC PARALYSIS".

CLINICAL SYMPTOMS & SIGNS:-

Circulatory System.

Heart.

(The following conditions are met with; those first
mentioned being the more common ones.)

Dilated heart.

Weak action heart

Irregular "

Intermittent "

Tachycardia "

Sounds " approximated

1st sound " faint

1st " " short

1st " " with systolic murmur

1st " " heard reduplicated at mitral and
tricuspid areas.

Galloping
rhythm "

Bradycardia "

Pulmonary systolic murmur of heart

Generally several of the above conditions are associated together. Thus it is frequent to find in the heart in a cardiac case: Dilatation, weak action, irregularity, intermittency, tachycardia, approximation of 1st and 2nd sounds, and a short faint first sound often with a systolic murmur. When galloping rhythm is observed it is generally near the finis.

Pulse.

Very fast generally.

Irregular frequently.

Hardly felt " (especially when death approaching)

Intermittent "

As a rule all the above are noted in cardiac cases, in some stage or other.

Then again, there is generally coldness of the extremities (hands, feet, ears) and blueness of skin and mucous membrane. Occasionally haemorrhages (small as a rule) subcutaneous or epistaxis. In some cases there is collapse, and very sudden death. The temperature is first two or three degrees up and then subnormal.

Respiratory System.

Breathing may be laboured and there is occasionally sighing respiratory act. Oedema of lungs not infrequent.

Alimentary System

Stomach.

Vomiting (one characteristic symptom).

Urinary System

Kidneys.

Albuminuria almost invariably, suppression of urine not infrequent, haematuria occasionally.

Nervous System

Convulsions, drowsiness, delirium - occasionally.

Restlessness - frequently.

The above enumerates the chief symptoms and signs in cardiac paralysis, though of course there are others but these perhaps are the ones worthy of mention.

Now, arguing from the above facts WHAT PATHOLOGICAL CHANGES MIGHT WE EXPECT TO FIND in cases of Cardiac Paralysis:--

Re Heart.

Degenerative changes of muscle fibres, such as fatty degeneration might account for:

Dilated heart

Weak heart action

Intermittent heart

Irregular "

1st sound heart faint

1st " " weak

1st " " short

1st " " with systolic murmur.

collapse and sudden death.

So in short for nearly all the clinical symptoms and signs mentioned under heart (supra) though many perhaps follow upon the dilatation.

Re Pulse.

Weak pulse

Irregular pulse

Fast "

Intermittent "

Then perhaps by "backward pressure" may account for some of the respiratory, urinary and stomach symptoms, and the general blueness of skin and mucous membranes, and with a feeble circulation we would expect coldness of extremities. Indirectly also this may account for nervous symptoms.

It is not for a moment presumed that some process of degeneration as fatty, accounts for all the above symptoms, not at all, as the toxin, or whatever caused the degenerative changes in the heart might account for various changes in the other organs; still we know the clinical picture of a failing heart.

Then one thinks also of blocking of one of the coronary vessels, with subsequent degeneration of muscle fibres; parenchymatous degeneration of muscle fibres; or fragmentation and segmentation of muscle fibres, with the generally associated conditions such as fatty degeneration, etc. (though this could as a simple form only account for the cases of very short duration); hyaline degeneration would be unlikely to occur in such a comparatively acute process; acute myocarditis has to be thought of also. Then acute valvular disease, or pericarditis with effusion are not very common in diphtheria, and would not account for all the peculiar features of a case of cardiac paralysis, besides having distinctive features of their own not present.

Then may be, some part of the nervous system is at fault, such as the vagus nerve, etc., yet such would be unlikely alone to account for the typical picture of a case, and this is especially an investigation to find the changes, if any, to be found in the heart.

In short, one may say that the lesions most to be expected are, perhaps:--

Fatty degeneration of the muscle fibres, heart-						
Parenchymatous	"	"	"	"	"	"
Fragmentation and Segmentation	"	"	"	"	"	"
Acute myocarditis	"					"

and perhaps associated with the above may be some lesion of nervous mechanism of the heart.

Re Stomach.

The vomiting, a characteristic symptom of cardiac paralysis in diphtheria, may be accounted for by some peculiar condition of the 'vomiting centre' in the medulla, or again to the 'vagus nerve' -- on the other hand there may be some 'local condition' of the stomach, which acting as an irritant causes the vomiting, and this condition may be primary, or secondary to some other process. The local condition may be a catarrhal, congestive, degenerative or inflammatory one, etc.

Re Kidney.

Some congestion, or acute inflammatory process appears as a probable renal condition.

II. HOW MIGHT ONE PROCEED TO INVESTIGATE THE
SUPPOSED OR POSSIBLE CHANGES DEDUCED ABOVE?

Heart.

I have used as good general stains the double staining with haematoxylin and eosin, and these act excellent to demonstrate most of the possible pathological changes mentioned under heart. For a change I have tried borax carmine and also alum carmine/

carmine. For demonstrating the fatty degeneration of muscle fibres osmic acid in some form (such as Marchi's fluid) has been used.

I have used Borax carmine and double staining with haematoxylin and eosin and an osmic acid (Marchi's fluid) for:-- Kidney, liver, bladder, intercostal muscle, diaphragm, stomach, spleen.

Spinal cord & Nerves

Cells.

Carmine in some form as Beale's ammonia-carmine fluid, or borax carmine solution of Grenacher or Lithia-carmine fluid of Orth. Haematoxylin as acid-haematoxylin (Ehrlich). Aniline blue-black as recommended by Bevan Lewis. Methylene blue as Nissl's method. Golgi's methods. Then for double stains the Ehrlich-Biondi mixture and also haematoxylin and eosine are excellent. For fibrillae between Nissl's corpuscles Cox's method.

Neuroglia

This is stained tolerably in some of the above, and the vessels are more or less shown up. But some such stain as Weigert's neuroglia stain gives good results with the neuroglia.

Axis Cylinders.

Aniline Blue-Black method, or Upson's chloride of gold method, or Benda's iron-haematoxylin method. Medullary sheaths.

Weigert-Pal method (and if followed by alum carmine/

mine shows up the axis cylinders and nuclei), Marchi's method for showing degenerations and if necessary counter-staining by Weigert's method or carmine.

ORGANS EXAMINED.

Heart: Left and Right ventricles.

Both vagus nerves:- from lower part neck.

Spinal cord: cervical, dorsal and lumbar regions.

Diaphragm muscle.

Intercostal muscle.

Stomach: fundus and posterior surface.

Kidneys.

Bladder.

Liver: near surface organ.

Spleen: " " "

HARDENING FLUIDS EMPLOYED.

Muller for vagus, diaphragm, stomach, heart, intercostal muscle.

Marchi for vagi, heart, kidney, stomach, cord, diaphragm.

Absolute alcohol for cervical, dorsal and lumbar cord.

Methylated spirit for heart, stomach, kidney, vagi, and liver.

Muller and 4% Formol for heart, bladder, diaphragm, stomach, kidney spleen, cord and right vagus nerve.

EMBEDDING METHODS.

Paraffin,

Celloidin.

Gum.

III- PARTICULARS AND RESULTS OF FOUR CASES EXAMINED.

CLINICAL NOTES.

Case (1)

William H., aged 3 years; admitted 22nd Jan. 1900. Taken ill 18th January. No rash. Heart normal. Membrane on both tonsils. adenitis, nasal discharge.

23rd Jan. Much nasal discharge, still membrane on both tonsils. Feeding fairly well. Very large thick piece of membrane came away from nose on syringing.

24th Jan. Temperature lower, feeding well, still much nasal discharge, inclined to epistaxis.

25th Jan. Temperature still up, much nasal discharge, feeding well, sleeps well.

26th Jan. Temperature lower, still epistaxis, but feeding and sleeping well.

27th Jan. Temperature up, glands much swollen, no rash, no vomiting, takes food well.

28th Jan. Temperature still up, left neck much swollen, feeding well, sleeping well. 3 p-m. vomited several times.

29th Jan. Vomited twice in the night, very ill, temperature lower, very restless when awake.

On the 29th Jan. I made the following notes (only a very casual examination could be made, as patient/

patient was very ill.)

Heart -- A.C.D. to left nipple line, and on right side to half a finger's breadth to right of the right border of the sternum; while above it extended to 2nd intersostal space left side.

A.B., difficult to exactly locate, as so very faint.

Mitral area: the 1st sound short and faint, the 2nd accentuated and very soon following the 1st.

Action of heart: very fast but regular.

Pulse -- Cannot be felt at either radial artery.

Colour -- Patient is cyanosed.

Vomiting -- Continues.

Enema -- Not retained.

Cervical Glands -- Enormously swollen, especially on left side where at angle of jaw looks like forming an abscess.

Epistaxis -- A small amount.

Liver -- Two fingers' breadth below costal margin in right nipple line.

Lungs: Nil in front found, but too ill to examine properly.

Teeth -- Sordes.

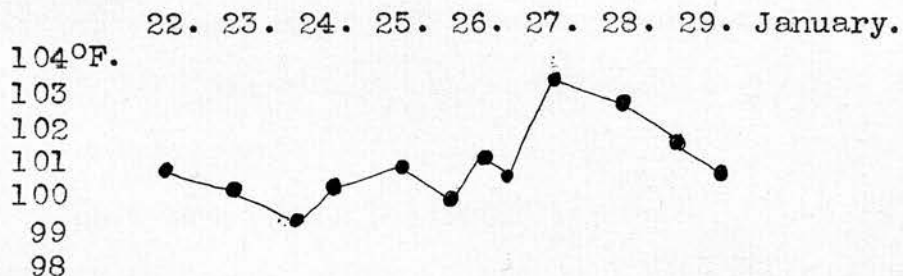
Extremities -- Cold-

Expression -- Very apathetic.

Urine -- Passing small amount, but could not be collected.

(A.C.D. = Area cardiac dulness: A.B. = Apex beat of heart.)

Temperature Chart.



Diet:

January 22nd, Milk.

January 28th, rectal feeds.

4 oz. peptonised milk 3 hourly.

Medical Treatment:

January 22nd Antitoxin 6,000 units.

Syringing nose with Boric lotion.

Enema saponis.

January 23rd Antitoxin, 6,000 units.

Death took place on 29th January, the case being one of Cardiac Paralysis.

Duration of Illness: 11 days.

POST MORTEM EXAMINATION.

(Made by myself)

On 30th January, 23 hours after death. Body fairly well developed. Post mortem rigidity well marked in legs. Hypostasis at back of chest and outer/

outer side of thigh. Many haemorrhagic areas at side and back of chest, also on inner surface of thigh, and laterally and posteriorly on neck. Slight oedema of legs.

Pericardium: Contains about $1\frac{1}{2}$ oz. of brown yellow fluid, and parietal membrane is a little dulled.

Heart: Weighs 3 oz. or

Left Ventricle, -- a little pale, valves slightly thickened at their margins, small antemortem clot.

Right Ventricle, -- some decolorised clots at apex and infundibulum extending into the pulmonary artery.

Right Auricle, half filled with antemortem clot.

Coronary Arteries, openings patent.

Semilunar valves. Normal.

Aorta: Healthy.

Trachea and Bronchi: Injected.

Pleural sac, left: Contains 8 oz. of light brown fluid, parietal pleural membrane lost much of its shiny appearance.

Pleural sac, right; Contains some 3 oz. blood stained fluid. Great adhesions between parietal and visceral pleura all over right lung except at base. These adhesions are fairly easily broken down. Parietal pleural membrane rather dulled.

Left Lung: Very oedematous, a little congested, floats in water.

Right Lung: Adhesions between the different lobes, oedematous all over, especially base, which is likewise congested, floats in water.

Abdominal cavity: Contains about 4 oz- yellow fluid, parietal membrane dulled laterally and posteriorly.

Bladder: Firmly contracted and empty.

Right Kidney: Weighs $2\frac{1}{2}$ oz., capsule slightly adherent; cortex looks a little diminished, kidney substance rather friable.

Left Kidney: Weighs $2\frac{3}{4}$ oz. The rest as for right.

Spleen: firm, weighs 3 oz.

Liver: Weighs 1 lb. 9 oz. some lobules very pale, few small antemortem clots in branches of hepatic veins.

Gall Bladder -- normal.

Stomach: Many punctiform haemorrhagic areas on anterior and posterior surfaces, also a few at fundus.

Spinal cord: Membranes a little congested.

Cervical Glands: At angles of jaw much enlarged, especially on left side, and on section some of them contain a small amount of soft yellow material in their interior.

PARTS OF ORGANS, ETC., TAKEN FOR MICROSCOPIC EXAMINATION AND HARDENING FLUIDS USED.

Stomach, posterior surface and fundus

Right Kidney

Liver from surface

} In
Methylated
Spirit.

Heart:

Left Ventricle near auricle and septum.

Right Ventricle, ditto.

Intercostal muscle, right side.

Right vagus nerve

Left vagus nerve

Taken 1 inch
below cricoid

In
Muller's
Fluid-

Spleen.

Cervical Spinal Cord, near dorsal cord

Dorsal Spinal Cord, near Lumbar cord.

Lumbar Spinal Cord,

In
Absolute
Alcohol.

STAINS.

Nissl's method; Weigert-Pal stain; Osmic acid in the form of Marchi's fluid; haematoxylin, eosin, and borax carmine.

EMBEDDING METHODS.

Paraffin, Gum, Celloidin.

CONDITIONS, PATHOLOGICAL OR OTHERWISE, FOUND IN
ORGANS, ETC., EXAMINED.

Heart:

Left Ventricle: Fairly

Fairly extensive fatty degeneration.

Striation a little faint.

Some fibres are rather atrophied.

Segmentation and fragmentation present.

Vessels greatly engorged.

Acute Myocarditis.

Left Ventricle

33. W. H.



Right Ventricle

31. W. H.



Left Ventricle

17. W. H.



Right Ventricle:

Extensive fatty degeneration.

Striation rather faint of some fibres.

Diffuse myocarditis.

Some fragmentation and segmentation.

Capillaries engorged.

StomachFundus, & Posterior Surface.

Surface cells of mucosa show post mortem degeneration.

Lymphoid cells are a little increased in number.

Right Kidney

The capillaries of Glomerulus all little dilated.

Many of the tubes are granular (? P.M. change)

Some hyaline and cellular casts.

Liver

In Glisson's capsule there are in some cases a few small round cells.

Some little cells near Glisson's capsule are cloudy, while near the central vein many cells are angular, elongated and atrophied. Nucleus often small, some clear spaces in the cells (? fat) Capillaries near central vein dilated.

Spleen

Congested.

Malpighian corpuscles prominent.

Vessel walls thickened.

Intercostal Muscle

Nil.

Spinal Cord

The cells of the anterior horns appear normal in number, distribution, shape, size, processes, granules, nucleus,

No pathological change found in cord.

Right Vagus Nerve

Congestion of vessels.

Otherwise nil detected.

Some of the fibres a little irregular in contour.

Left

Left Vagus Nerve

Vessels dilated.

RELATION OF PATHOLOGICAL CHANGES TO THE CLINICAL
SYMPTOMS AND SIGNS.

The clinical facts mentioned about the heart could all be accounted for by the changes found post mortem in the heart, and so of course could the general condition, as coldness and blueness. The vomiting perhaps may be due to some slight condition of the stomach or vagus nerve.

CLINICAL NOTES.

Case (2)

Harry R., 1 year, one month. Admitted 22nd February, 1900. Taken ill, 18th February. Head-ache, vomiting, nasal discharge, glands swollen in neck.

22nd Feb. Some membrane present on both tonsils, extending on to soft palate, cervical glands swollen, no rash.

23rd Feb. Much nasal discharge, taking food fairly well. Sleeping fairly, fretful, temperature 38°C . throat very dirty, small piece membrane inside upper lip.

24th Feb. Very ill, taking food well, temperature lower, less profuse nasal discharge,

26th Feb. Slept well, but takes food unwillingly, temperature normal, cold this morning, not vomited, less nasal discharge, looks ill, heart sounds flapping and irregular, pulse small.

27th Feb. Rather better, takes food unwillingly.

28th Feb. Vomited once this morning, colour bad, temperature normal.

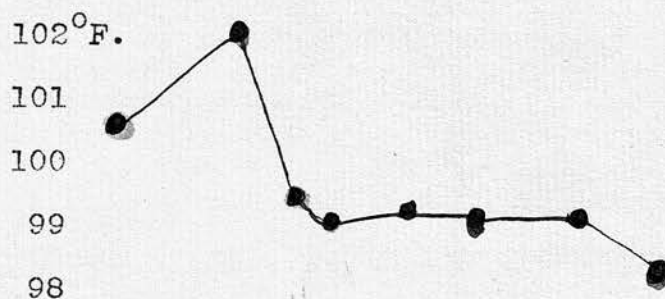
Diet: Low diet and beef tea.

Medical Treatment: 9,000 units antitoxin.

Urine: No specimen obtainable.

Temperature Chart

Day of Month. 22. 23. 24. 25. 26. 27. 28.

Duration of Illness: 11 days.Death: 1st March, 1900.

POST MORTEM EXAMINATION-

Made by myself. 36 hours after death on 2nd March-

Child moderately well developed. Hypostasis well marked on chest and limbs posteriorly. Lower limbs rigid, upper limbs slightly so.

Pericardium: About 1 oz. of straw coloured fluid present in sac.

Heart: Size, about normal. Weight, $1\frac{3}{4}$ oz.

Left Ventricle, muscle a little pale, small antemortem clot going up into aorta, valves a little thickened on margin.

Right Ventricle -- contains a small antemortem clot, valves normal.

Bladder: firmly contracted and empty.

Stomach: rather small, a few pin-point red areas at fundus ? haemorrhages; same on posterior surface.

Right Kidney: $1\frac{1}{2}$ oz. cortex a little pale.

Left Kidney: $1\frac{3}{4}$ oz. normal.

Spleen/

Spleen: $1\frac{1}{4}$ oz. normal. Liver: $12\frac{1}{4}$ oz. normal.

Pleura: Old pleuritic adhesions between upper and middle lobes, right lung.

Left Lung: Oedematous, little congested, floats in water,

Right Lung: ditto.

PARTS OF ORGANS, ETC., TAKEN FOR MICROSCOPIC EXAMINATION AND HARDENING FLUID USED.

Heart , apex of Left Ventricle

Stomach, from Fundus

Right Kidney, cortex and medulla

Spleen, near surface

Dorsal Spinal Cord, lower part

Right Vagus nerve, lower part neck

Bladder, from Fundus

Diaphragm muscle

Muller's fluid
with
4% Formol added

EMBEDDING METHODS-

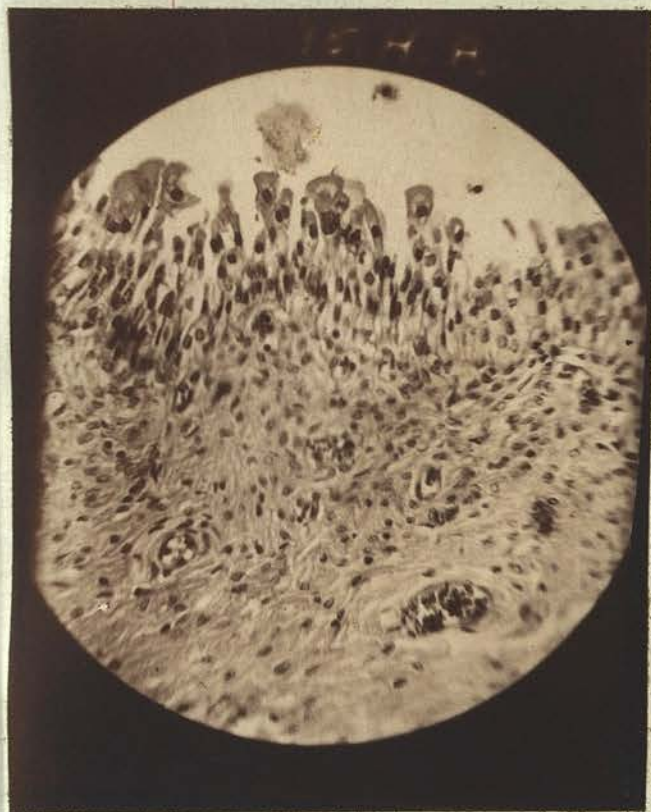
Paraffin

Gum.

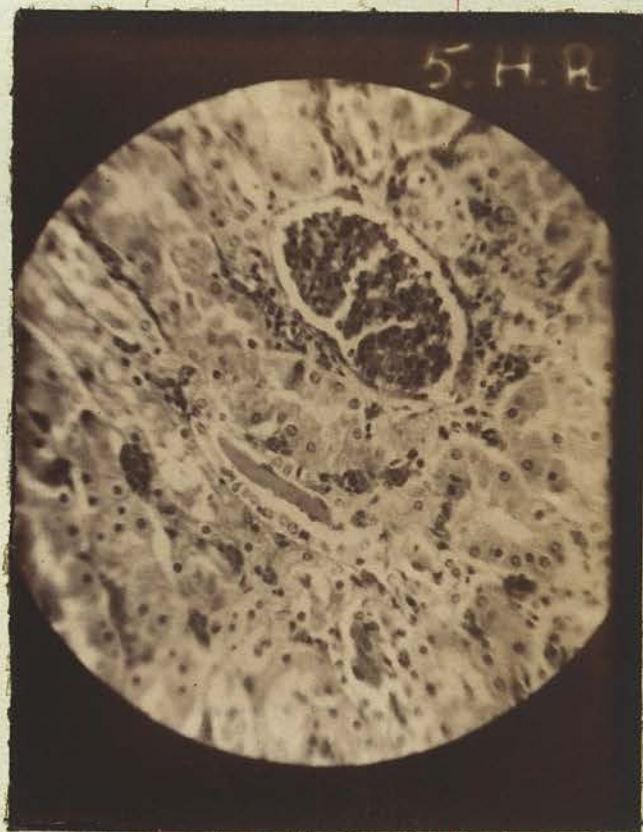
STAINING METHODS.

Marchi's fluid; Nissl's method; Weigert-Pal method; Haematoxylin; eosin; borax carmine; alum carmine.

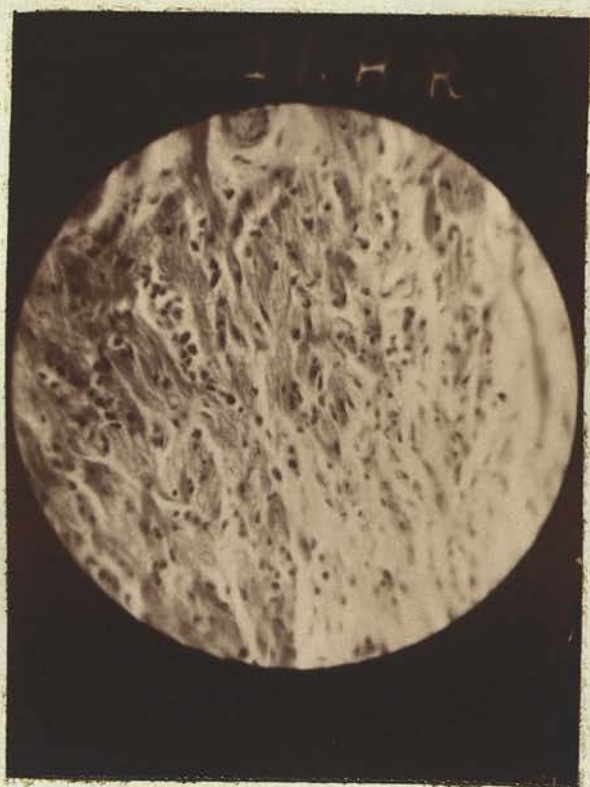
Bladder



Right Kidney



Left Ventricle



CONDITIONS, PATHOLOGICAL OR OTHERWISE, FOUND IN
ORGANS EXAMINED.

Heart

Left Ventricle

Fatty degeneration well marked in patches, in the muscular fibres.

Some fragmentation and segmentation present.

Some muscular fibres have lost striation.

Diffuse myocarditis, with fibrosis.

Stomach (cardiac end)

Lymphoid cells are little increased in number.

A few red corpuscles seen outside the vessels, here and there.

P.M. changes seen.

Right Kidney

Much engorgement of the vessels in cortex and medulla.

Capillaries of Glomerulus dilated with blood.

P.M. Changes present.

Liver

Capillaries of central part of lobules dilated.

Some cells flattened (? Haemorrhages)

Spleen

General Congestion.

Walls of small vessels thickened.

Malpighian bodies prominent.

(? Haemorrhages)

Diaphragm

Small vessels congested a little.

Some fibres not showing striation well and a few fibres are granular.

Some red blood corpuscles free amongst the fibres.

A few round cells present in parts.

Bladder

Some vessels beneath and also in mucous membrane dilated.

Casting off of cells from mucous membrane
(? P.M. change)

Spinal Cord

Seems normal, no changes in cells discernable.

Right Vagus nerve

Engorgement of vessels.

RELATION OF PATHOLOGICAL CHANGES TO THE CLINICAL
SYMPTOMS AND SIGNS.

Here also, as in the former case, the pathological changes found could account for the clinical signs in life.

CLINICAL NOTES.

Case (3)

Henry A. Aged 9 years. Admitted 5th January 1900. Taken ill on 29th December, '99. January 2nd, nasal discharge.

5th Jan. Membrane on both tonsils which are enlarged, slight swelling of glands.

6th Jan. Dirty yellow membrane on both tonsils, taking food well, coughs a good deal.

Heart, A.C.D. internal to left nipple line; sounds fair, rather rapid.

7th Jan. Fair amount of nasal discharge still, not so much coughing and expectoration. Throat much cleaner, good deal of inflammation.

Lungs: few rhonchi posteriorly, nothing in front.

Heart: A.C.D to left border of sternum and just internal to left nipple line, sounds fair, pulmonary 2nd sound a little accentuated.

8th Jan. Coughing a good deal, fair amount of nasal discharge, throat clean, tonsils large.

9th Jan. Bloody discharge from nose, expectoration is still sanguineous.

12th Jan. Boy suddenly taken with vomiting and pallor, clonic convulsions of limbs, urine passed involuntarily, colour and pulse bad, hypodermics of brandy useless, as was artificial respiration.

Diet: Milk and milk puddings.

Medical/

Medical Treatment:

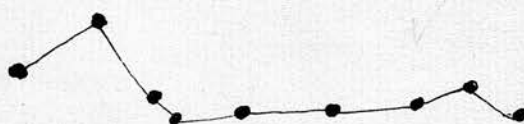
5th January, antitoxin, 9,000 units.

6th January, carbolic and boracic douches ordered.

Temperature Chart

22. 23. 24. 25. 26. 27. 28. February.

102°F.
101
100
99
98



Duration of Illness: 14 days.

Death took place on 12th January, 1900.

POST MORTEM EXAMINATION.

Made by self on 13th January, 28 hours after death.

Body rigid, wasted, pallor, few purpuric spots on left calf, hypostasis posteriorly.

Heart: A little dilated, flabby and slightly fraible.

Muscle looks rather pale, valves healthy- Antemortem clots in left ventricle, right auricle and right ventricle.

Pleura: Many adhesions between visceral and parietal pleurae on each side, but especially on left side.

Lungs: On section are both found to be oedematous all over and the bases of lungs are congested.

Stomach: A little dilated and a few small haemorrhages near fundus.

Kidneys: Pale, otherwise no change noted.

Spleen/

Spleen: Congested, dark colour.

Liver: Outer part of lobules rather pale, the central parts seem pigmented.

PARTS OF ORGANS, ETC., TAKEN FOR MICROSCOPICAL EXAMINATION AND HARDENING FLUID USED.

Left Vagus nerve

Right vagus nerve

Left ventricle of Heart, near to aortic orifice and to septum.

Right ventricle of Heart, near auricle and $1\frac{1}{2}$ inches from anterior part of septum.

Stomach, from fundus.

Right Kidney

Liver.

} Hardened
in
Methylated
Spirit.

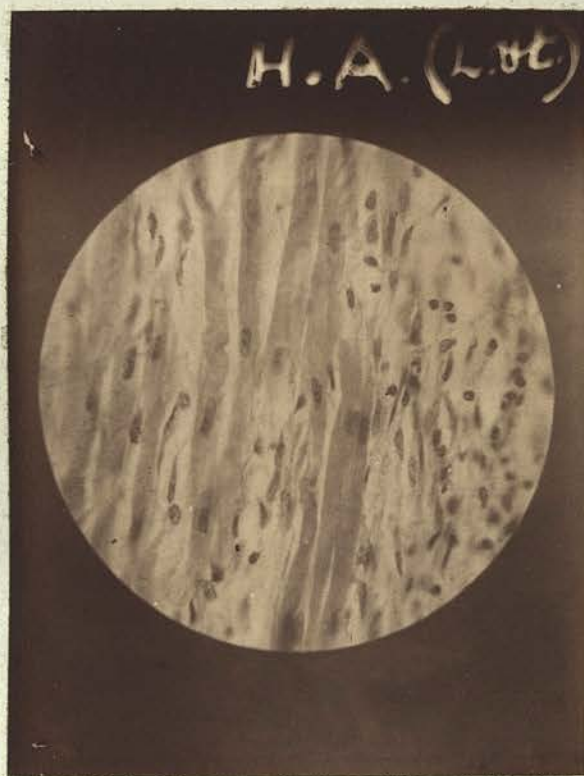
EMBEDDING METHODS.

Paraffin and Gum.

STAINING METHODS.

Haematoxylin, Eosin, Borax carmine, alum carmine, osmic acid in the form of Marchi's fluid; Weigart-Pal method; and Nissl's method.

Left Ventricle



CONDITIONS, PATHOLOGICAL OR OTHERWISE, FOUND IN
ORGANS EXAMINED.

Heart

Left Ventricle:

Segmentation and Fragmentation of muscle fibres.

Much loss of striation.

Capillaries a little dilated.

Fatty degeneration, of muscle fibres.

Acute myocarditis.

(This was perhaps the best marked case of
the series.)

Right Ventricle:

Fatty degeneration of muscle fibres.

Segmentation and fragmentation.

Acute myocarditis.

Stomach (Fundus)

The Increase of lymphoid cells

Some secreting cells, ? fatty.

P.M. changes seen.

Right Kidney:

Capillaries of the Glomerulus seem dilated.

Dilatation of vessels beneath the capsule.

In the cortex in some places red blood corpuscles seem to be extravasated into the kidney tissue.

Some hyaline looking casts in tubules.

P.M. changes seen.

Left & Right Vagus Nerves

No pathological change to be detected.

CLINICAL NOTES.

Case (4)

Alfred W., aged 5 years. Taken ill on 18th January 1900. Heart Normal, breathing rapid, much discoloured, membrane on both tonsils and palate, adenitis.

19th Jan. Very ill, taking food badly, temperature lower, much nasal sanious discharge, pulse medium, force, but weak, colour good, not croupy.

20th Jan. Rather better, croupy cough still, temperature normal, colour better, breath sweeter, not taking food by mouth much, much nasal discharge, albuminuria, pulse rather better, throat cleaner, but still membrane on uvula and palate.

21st Jan. Improving, taking beef tea and bread crumbs and some milk by mouth.

22nd Jan. Still some white membrane on uvula, throat otherwise clean, temperature normal, feeding better, pulse small.

23rd Jan. Uvula almost clean, doing well, temperature sub-normal, pulse fair.

24th Jan. Vomited after beef tea, retained breakfast since.

25th Jan. No further vomiting.

26th Jan. Vomited last night, very ill, pulse hardly perceptible, very restless.

Diet:

January 18th: Milk

" 21st Low diet

" 22nd Middle diet

" 26th Rectal feeding.

Medical Treatment:

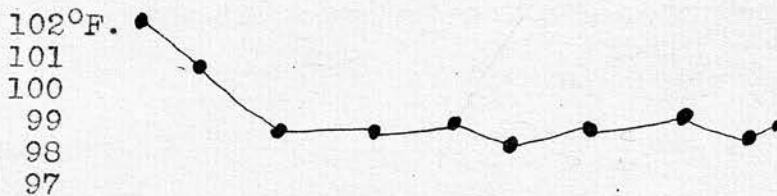
18th January, antitoxin 9,000 units, syringe with
chlorine gargle, swab throat with
perchloride .2%

19th January antitoxin 6,000 units.

20th January antitoxin 6,000 units.

Temperature Chart.

18. 19. 20. 21. 22. 23. 24. 25. 26. January.



Died on 27th January.

Cause of Death: Cardiac paralysis.

Total Duration of diphtheritic attack 9 days.

POST MORTEM EXAMINATION.

Made by self on the 29th January, 62 hours after death.

Post mortem rigidity mostly passed off, condition
of body tending to emaciation. Haemorrhagic spot
over sternum on a line just above nipples.

Pericardium: Contains a small amount of brownish
coloured fluid.

Heart: Weighs $5\frac{1}{2}$ oz.

Left Ventricle -- a little pale, a few small
antemortem clots present, free margins of cusps

a/

a little thickened-

Right Ventricle -- also a little pale, here also a few antemortem clots, free margins of cusps slightly thickened.

Coronary orifices are patent.

Aorta: Healthy.

Pleural sacs: About 2 oz. of brownish yellow fluid in each pleural sac. In posterior part of right lung, there was slight adhesion between the parietal and visceral pleural membrane.

Lungs: Both lungs rather oedematous and a little congested, especially at bases and posteriorly. A little emphysema at anterior borders of each lung.

Trachea and Bronchi: Rather congested.

Stomach: Appears to be a little enlarged and shows punctiform haemorrhages, especially over anterior and posterior surfaces, also a few at fundus and pylorus. These haemorrhages appear to be sub-mucous.

Spleen: Weighs 2 oz., rather firm.

Kidneys: Right weighs $2\frac{3}{4}$ oz. appears normal,
Left weighs $2\frac{1}{2}$ oz. normal.

Bladder: Firmly contracted and empty.

Liver: Weighs 25 oz. Lobules a little pale.

Gall Bladder normal.

Peritoneal cavity: Contains 6 oz. of brownish yellow fluid, but peritoneum appears normal.

Spinal Cord: Membranes of cord rather injected.

PARTS OF ORGANS, ETC., TAKEN FOR MICROSCOPICAL
EXAMINATION AND HARDENING FLUIDS USED.

Liver.

Right Kidney

Stomach from Fundus

Casts from nose

Methylated
Spirit.

Cervical cord, lower part

Dorsal cord " "

Lumbar cord, " "

Absolute
Alcohol.

Right vagus nerve, just below cricoid

Left " " " " "

Diaphragm muscle, right side

Stomach from Fundus

Spleen

Heart, right ventricle near auricle & septum

" left " " " " "

Right Intercostal muscle. (5th space)

Muller

EMBEDDING METHODS

Paraffin Gum.

STAINING METHODS-

Haematoxylin, Eosin; borax carmine; alum carmine;

Marchi's fluid; Nissl's methos; Weigart-Pal method.

CONDITIONS, PATHOLOGICAL OR OTHERWISE, FOUND IN
ORGANS EXAMINED.

Heart

Left Ventricle:

Extensive fatty degeneration.
Segmentation and fragmentation.
Some fibres lost striation.
Acute myocarditis.

Right Ventricle:

Fatty degeneration present.
Fragmentation and segmentation.
A little fatty infiltration.
Some fibres granular.
Vessels dilated.
Acute myocarditis.

Stomach (cardiac end)

Lymphoid cells nearly all over mucous membrane
and a few leucocytes seen amongst them.
Great P.M. digestion of mucous membrane.
Some round cells around smaller vessels in
muscular layer.

Liver

P.M. changes present.
Capillaries enormously dilated and engorged with
blood, in lobules.
Great dilatation also in Glisson's capsule,
? Haemorrhages in some lobules.
Some liver cells have nucleus faint.
Many cells small and compressed, especially near
intra-lobular veins.

Left Ventricle



Spinal Cord.



Spleen

Great engorgement and haemorrhages.

Vessel walls a little thickened.

Malpighian corpuscles prominent.

Kidney:

Great P.M. changes.

Many hyaline looking and cellular casts in tubules, all over.

Engorgement of vessels in medulla.

Intercostal Muscle:

Some fat between muscle fibres.

Little increase of fibrous tissue.

Otherwise nil.

Diaphragm

A very few fibres show slight fatty change.

Around some of the vessels some round cells are seen.

A slight amount of fatty infiltration.

Striation in some fibres little faint.

Right Vagus Nerve

Congestion of vessels, otherwise nil seen.

Left Vagus Nerve

Nil seen.

Spinal Cord

Nothing abnormal noted.

RELATION OF PATHOLOGICAL CHANGES TO THE CLINICAL
SYMPTOMS AND SIGNS.

Here, as in all the four cases, the pathological changes found in the heart, at any rate, coincided with what might be suggested by clinical symptoms. The condition of the stomach has not been of sufficient pathological importance to be of much value, as revealed microscopically.

I have read most of the works that have been produced on Post Diphtheritic Paralysis, but as it would be useless and impossible to quote from all of them, I merely mention here a selected few.

IV. COMPARISON OF RESULTS FOUND IN THIS THESIS, WITH THE LITERATURE.

Re Heart and Muscles generally.

(1)
Martin, experimenting on rabbits, finds that
"The nerve degeneration is associated with fatty
degeneration of the muscles which is proportional
to the degree of degeneration"; and he continues,
"the heart in all cases shows advanced fatty degener-
ation."

(2)
Sharp says: "Diphtheritic poison is to be
classed with the acids which have as their final
action the stoppage of the heart muscle in diastole."

Hunt(3) mentions the following: "the poison
in animals induced fatty degeneration of the muscles
in general, including the heart. If the poison
were intense it caused inflammation and necrosis of
the tissues; if dilute, it set up progressive degener-
ation".

Mohr(4) said: "He had found early and late fatty
degeneration of muscles and sometimes Wallerian de-
generation of the nerves."

- (1) S. Martin: "On the Causation of Diphtheritic Paralysis" Proc. Roy. Soc. Lond., 1892. L. I. pp. 78-81.
- (2) G. Sharp: "The Action of the Products of the Organism of Diphtheria on the Heart Muscle of *Rana Temporaria*" J. Anat. & Phys., Lond. 1896-7 XXXI. p.199
- (3) B. Hunt: "The Pathology of Diphtheria" B.M.J. London, 1895 I., p.532.
- (4) G. Woodhead (v.d.) "Post-Diphtheritic Paralysis" (Abst.) B.M.J., Lond., 1898. II. p.595.

Baginski⁽¹⁾ said his assistant, Dr Katz, had found extreme degeneration of muscle fibres of heart and diaphragm.

Dr Woodhead⁽²⁾ said: "He believed the heart failed earliest and most frequently, because it was the organ that got least rest."

Trevelyan⁽³⁾ mentions that: "The changes in the heart are of great importance, as the larger proportion of cases of sudden death in diphtheria are connected with a profound alteration of the cardiac muscle." He found marked fatty degeneration in the muscle fibres of the myocardium. Striation remained in some fibres, but lost or obscured in others. Muscle nuclei were indistinct; the interstitial tissue seemed to be very little affected and he thought the lesion to be acute^{degenerative} myocarditis, finding no evidence of cellular exudation about the minute vessels.

Villy⁽⁴⁾ in a series of 15 cases, found fatty degeneration in the heart in 14 of these cases, granular changes in the fibres and indistinctness or loss of their striation in 15 cases, haemorrhages in 7 cases. Ante mortem clot was found in its cavities eight times.

(1) & (2) V.d. Woodhead, idem our work.

(3) E. Trevelyan: "Some Points on the Pathology of Diphtheria" Lancet, Lond., 1896, I. p.227.

(4) F. Villy: Pamphlet reprinted from Medical Chronicle, Sept. 1899 . p.25.

Re Nerves and Spinal Cord

Martin⁽¹⁾ found experimentally in rabbits "Nerve fibres were found extensively degenerated, while spinal cord, spinal ganglia and brain were normal; the degeneration of nerves being segmentary" He continues: "The degeneration affects the segment of the nerves, the fibres at that point lose their white substance of Schwann, and the axis cylinders get often wasted and ruptured. If the axis cylinders get ruptured, the nerve fibres below the point get Wallerian degeneration. Above the degenerated segment the nerve is normal, the changes being peripheral, not central in origin. All nerves in the body may be affected by this degeneration - the motor, sensory, visceral (sympathetic)."

Kidd⁽²⁾ mentions the following: "Diphtheritic paralysis was founded on a distinct anatomical lesion of the spinal cord which affected the anterior horns and consisted in alteration of the shape of the motor nerve cells, and in changes in their cell protoplasm. The affected cells were as a rule more or less globular in shape and devoid of processes." He continues: "The cell degeneration had an atrophic tendency. In some cases sections from special parts showed a numerical atrophy of motor nerve cells." He proceeds: "The localisation of the nerve lesion corresponded with the distribution of the muscular paralysis during life."

(1) S. Martin: "On the Causation of Diphtheritic Paralysis" Proc. Roy. Soc., Lond 1892, L I. pp. 78.- 81.

(2) Kidd: "Contribution to Pathology of Diphtheritic Paralysis" (Abst.) B.M.J. Lond., 1883. I. p.57.

Trevelyan⁽¹⁾ found no lesion in a case of diphtheritic paralysis that he examined, in the pneumo-gastric nerves. (The case was one of cardiac paralysis.)

Batten⁽²⁾ found parenchymatous degeneration of nerve fibres. He examined six cases, four of which gave positive results, and in two of these the vagi were affected, while the phrenics were affected in all four cases. He says that affection seems to be primary peripheral, but Mouravjeff has shown that changes in the cells of the anterior horn occurred during the first weeks after infection, whereas parenchymatous changes in the nerves were most marked five to six weeks after infection, at which time the cells of the anterior horn had recovered or had undergone atrophy.

Thomas⁽³⁾ examined vagus nerve in 25 cases of diphtheria and found degeneration in nearly every case.

Oertel⁽⁴⁾ found in diphtheritic paralysis capillary haemorrhages in the dura mater of the cranium and spinal cord, as well as in the sheaths of the peripheral nerves and inflammatory condition of the anterior horns.

- (1) Trevelyan: "Some Points in the Pathology of Diphtheria" Lancet, Lond., 1896 I. p.227.
- (2) Batten, F-E-: "The Pathology of Diphtheritic Paralysis; a Paper based on the examination of six cases of that Disease by Marchi's method" B.M.J., 1898, Lond., II. pp.1540-1546.
- (3) Thomas: v.d. (2).
- (4) Oertel: v.d. (2).

Bailly ⁽¹⁾ in 1872 asserted that paralysis sometimes depended on lesion of the peripheral nerves, sometimes also on an affection of the muscles.

Meyer ⁽²⁾ found in a man aged 17 with diphtheritic paralysis, where infection 50 days previous to examination and paralysis 21 days, that there was some degeneration in the fine branches of the 5th, 7th, 9th and 10th nerves, but less than in the phrenics and glossopharyngeal.

Martin ⁽³⁾ found breaking up of the white substances of Schwann in the motor nerves, but all parts near origin or nerves were normal, and affected near entering muscle. Primitive sheaths remained intact, the axis cylinders were often intact. No interstitial change and no increase in nuclei, the process is one of degeneration of nerve fibres.

- (1) vide (2) previous page.
 (2) vide (2) " "
 (3) vide (2) " "

re Kidneys.

Trevelyan (1) writes thus:-

"The kidneys in excreting bacterial poison are almost always injured sometimes in a slight, and at other times in a marked degree". He continues "the microscope reveals evidence of acute toxic nephritis." In one case which he examined he found the changes were chiefly in glomeruli and tubules. The capsular epithelium showed unmistakeable signs of proliferation. The tubules were frequently found filled with a homogeneous exudation.

re Spleen.

Trevelyan (2) mentions that it is frequently enlarged partly owing to vascular engorgement, and partly owing to proliferated changes in its parenchymatous elements.

re Liver.

Trevelyan (3) noted that it was slightly enlarged, the cells showing evidence of cloudy swelling.

(1), (2), & (3) Trevelyan: "Some points in the Pathology of Diphtheria," Lancet, Lond., 1896, I. p.226.

Re Stomach

Villy (1) found that out of 15 cases which he examined the stomach showed fatty degeneration of the glandular epithelium in all, an excess of leucocytes in the mucous and sub-mucous layers in all, haemorrhages in the mucous membrane in 8.

Nearly all investigators into paralysis following diphtheria have found marked fatty degeneration of the cardiac muscle and this agrees with the results that have been obtained in the four cases examined.

But besides the degenerative changes mentioned by most workers on this paralysis there is no doubt that the inflammatory condition is also one of great importance and is well marked, as has been seen in the cases just quoted.

In/

- (1) Villy: Pamphlet reprinted from Medical Chronicle
Sept- 1899., p.25.

In regard to the vagus nerve, many of the authors which have been just previously mentioned, have found a parenchymatous degeneration of the vagus nerve. I have said in each of the cases very little as to the condition of the vagus nerves because I do not consider that the slides which I made of them were satisfactory enough to pass a definite opinion upon them; yet the condition of engorgement of the vessels which has just been described in the cases of this series agrees with what has been often described before.

Re the Stomach, I was unable to find all the various changes which were described by Villy.

The changes found in these cases in the kidney and liver agree fairly well with what has been mentioned in the literature, though many changes which I noted in the kidney I put down to post mortem changes and are just mentioned in these notes as P.M. changes.

Re the Diaphragm, I have not been able to find the extreme fatty degeneration described by Dr Katz, though great changes have been found in the hearts in this series.

The condition of the spleen all through has been interesting and as Trevelyan mentions it is engorged; the Malpighian corpuscles are enlarged also. In some cases I have found haemorrhages.

The bladder has throughout shown no particularly noticeable feature.

In the cells of the anterior cornu of the cord I could find no change.

V. SUMMARY.

In all four cases examined the heart was found to have undergone extensive fatty degeneration, etc., and also to be in the condition of acute myocarditis. Where both ventricles were examined, the same condition was found in each of them, though sometimes it was a little more marked in the right, at other times in the left ventricle.

In all the four cases of the series, also, both the right and the left ventricles of the heart contained ante mortem clots, and in some cases they were of large size and going up to the pulmonary artery and aorta respectively. On a section which I made of one clot it had the usual appearance of an A.M. clot under the microscope.

So we may very definitely say that whether changes in the vagus

^ have, or have not, anything to do with what has been described as Cardiac Paralysis in Diphtheria, one thing is certain that in all these cases profound and definite changes of the nature described above are always present, and these changes must carry great weight when we think of the clinical condition of cardiac paralysis in Diphtheria.

As regards the condition of the stomach, I do not consider that it was at all of sufficient importance to merit one looking upon the slight conditions^{found} post mortem to say that they were definitely responsible for the gastric symptoms.

Certainly post mortem the stomachs have the appearance of having small haemorrhages beneath the mucous membrane, but at any rate I have not found the changes which one might have expected with a microscope.

The oedematous and congested condition of the lungs are only what one would expect under the clinical picture.